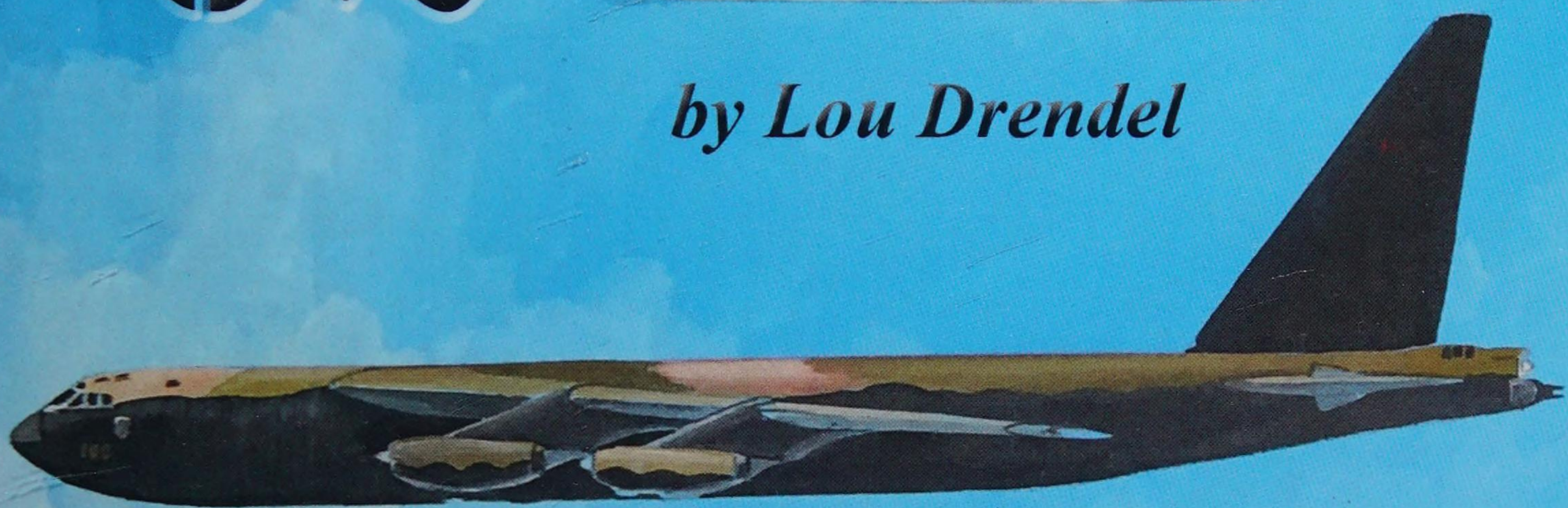


B-52

STRATOFORTRESS ILLUSTRATED



by Lou Drendel



Lou Drendel

Aviation Art, Inc



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Foreword

The first thing to know about the Boeing B-52 Stratofortress is that it is a remarkable airplane for many reasons, not the least of which is its longevity. The first flight of the B-52 was in 1955 and the production line shut down in 1962 after cranking out 742 bombers in 8 different models. Sixty years later, the B-52 is still flying, and plans are to keep it flying for several more years. Of course, the B-52 of today is not your Grandfather's B-52. (Think about that! At least three generations of USAF pilots have flown the B-52!) When remarking about an aircraft, it is usual to compare it to its contemporaries, but until the B-1 and B-2 came along, the B-52 had no contemporaries. Oh, the Russians had their Bison and Bear, and later the Backfire and Blackjack, but none of them have compiled records that compare to the B-52. B-52 crews refer to their airplane as the "BUFF" (Big, Ugly, Fat Fucker), an unflattering sobriquet probably first applied by one of their grandfathers, who might have wished he was flying a Century Series Fighter instead of the B-52. Big it is, but I don't think many would consider it fat or ugly, though I am sure those on the receiving end of its weapons would (and probably have) used the last word to describe the remarkable B-52.





When the prototype B-36 arrived at Carswell AFB, a B-29 was parked next to it to accentuate the growth of SAC bombardment.

Introduction

World War II was the first truly global war, and it put permanent end to the isolationist bent of most Americans. The Atlantic and Pacific Oceans were no longer the barriers that would keep the enemy from the homeland. Early in the war, when it looked like it was possible that Germany would control all of the continent AND England, American planners realized they would have to build a strategic bomber capable of reaching European targets from North America. The attack on Pearl Harbor only accentuated the need for long-range bombers, and this requirement led to the Convair B-36 Peacemaker. The B-36 was the largest mass-produced piston engined aircraft ever built. It had the longest wingspan of any combat aircraft ever built at 230 ft., a range of 10,000 miles, and a maximum payload of 72,000 lbs. It was the world's first manned bomber with an unrefueled intercontinental range. First flown in 1946, the B-36 became operational in 1949 and served until 1959. 384 B-36s were built.

During the long gestation period of the B-36, it became increasingly obvious that it would be obsolete shortly after its operational introduction. Air Force planners began thinking about the next generation bomber. The piston-powered, relatively slow, B-36 continued to be the only intercontinental nuclear bomber because it was the only bomber capable of carrying the large early A and H bombs internally. The jet-powered B-47 did not have the unrefueled range to reach Soviet targets, and was not capable of carrying the larger nuclear bombs. 384 B-36s, under the command of General Curtis LeMay, was a powerful deterrent to Soviet expansionism.....at least, until the Soviets had the MiG-15, which had the capability to shoot down the high-flying, but slow, B-36.

While the B-47 did not have the range or the ability to carry the heavier nuclear weapons, it did prove the efficacy of the swept-wing, jet powered bomber. So, while the Boeing engineers continued to labor over the XB-52 design which featured turboprops and straight wings, the Air Force began to think about a larger, jet-powered, long-range bomber.

The original XB-52 design, (Boeing Model 462) selected by the Army Air Forces in 1946, was for a straight-wing heavy bomber, powered by six 5,500 shp Wright XT-35 Turbo props, turning six-bladed propellers. It was the dawn of the jet age, but straight turbojets would not have given the Model 462 the range required by the Air Force. The Air Force took a look at the Model 462 and concluded that it wasn't much different that the B-36, so Boeing submitted a revised proposal (Model 464), which was similar in configuration, but smaller and powered by 4 XT-35s. The Chief of USAAF Engineering Division, MG Laurence Craigie, liked it and recommended its adoption. He was outvoted by LeMay though and this resulted in the revised Model 464-16, which would be powered by uprated (8,900 shp) XT-35s. This was to be the long-range nuclear bomber, and Boeing also offered a shorter-range conventional model (464-17). Craigie and LeMay didn't like either one, and it was back to the drawing board for Boeing. The Boeing model 464 went through six iterations (464-16,



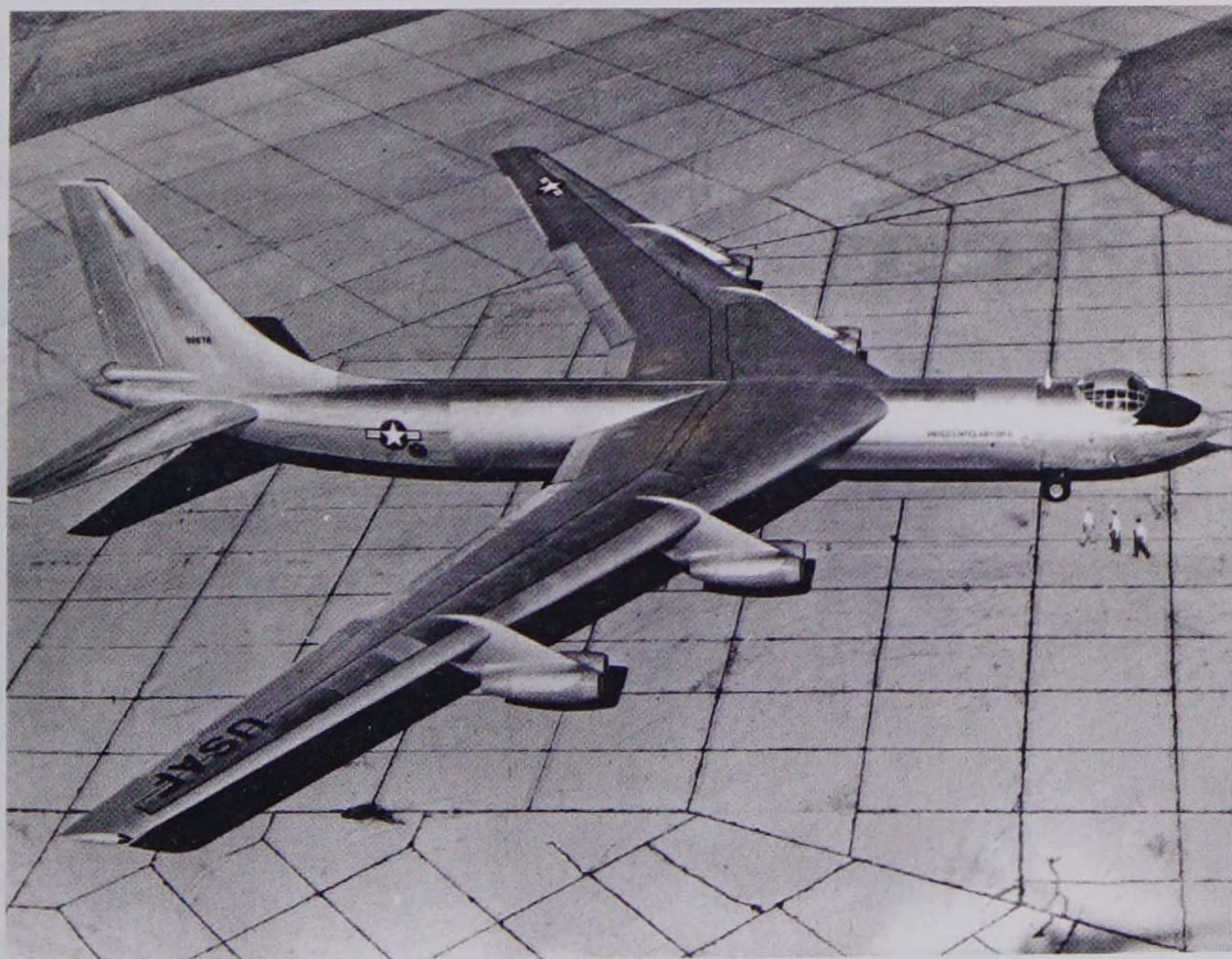
Beginning with the B-36D, Convair added a pair of General Electric J47-19 jet engines suspended near the end of each wing; these were also retrofitted to all extant B-36Bs. Consequently, the B-36 was configured to have 10 engines, six radial propeller engines and four jet engines, leading to the B-36 slogan of "six turnin' and four burnin' "



B-47 launches using JATO assist

17, 29, 35, 40, 49) before the last one was approved. These progressed from turboprop to pure jet power, but there was a marked lack of frenetic motivation until the Berlin Blockade of June, 1948 heated up the Cold War.

On Oct. 21, 1948, Boeing Chief Engineer Ed Wells and his design team were in Wright-Patterson AFB in Dayton, Ohio, when the Air Force's chief of bomber development told them to forget the turboprops and come up with turbojet bomber. Over the following weekend, in a Dayton hotel room, the team designed a new eight-engine jet bomber, still called the B-52, made a scale model out of balsa wood and prepared a 33-page report. The effort impressed the Air Force's Air Materiel Command, and the model 464-49 design was approved and eventually evolved into the model 464-67, the XB-52. There were teething problems along the way though, some caused by politics and some caused



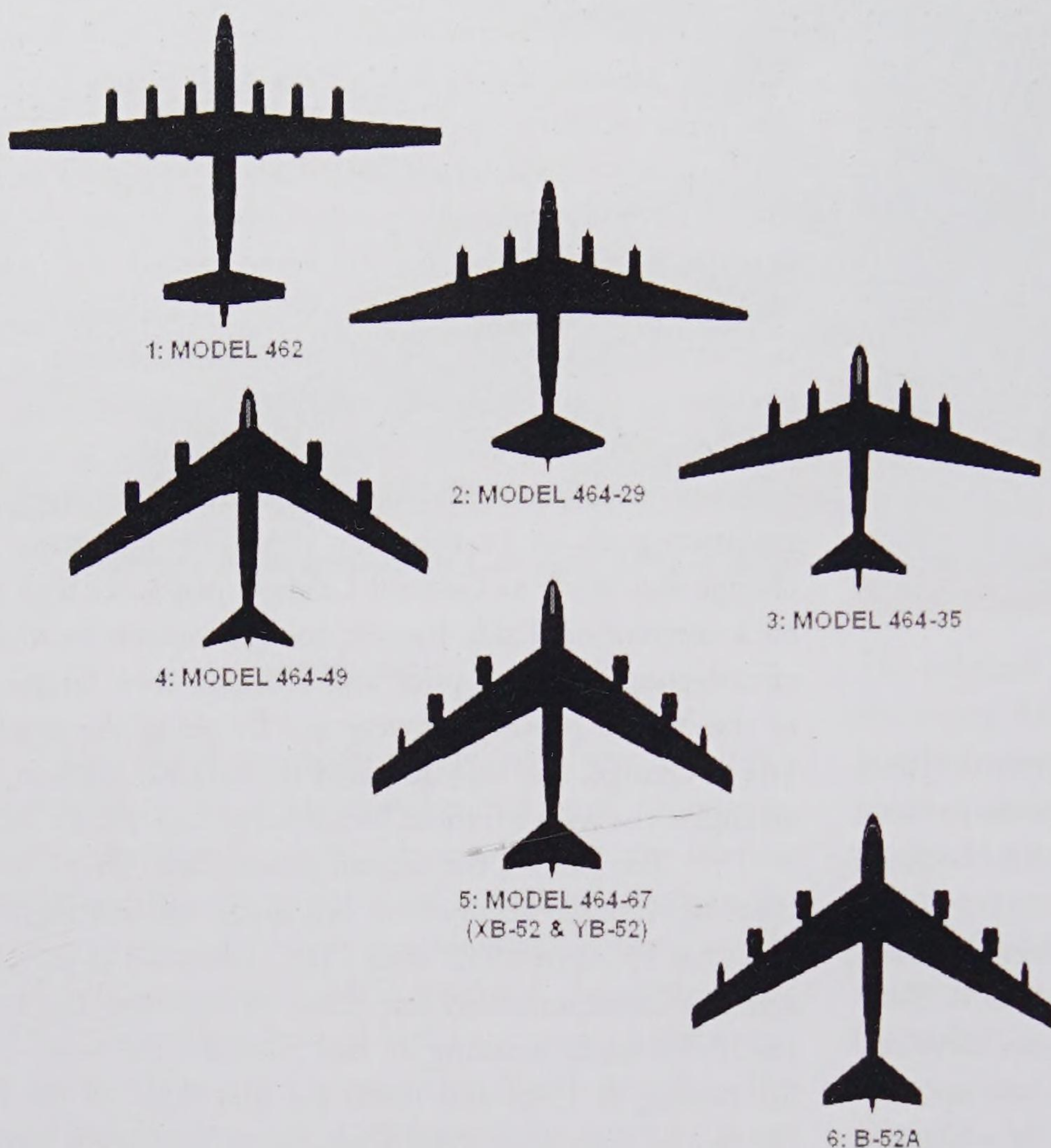
The Convair YB-60 (S/N 49-2676) was a losing contender for the XB-52 contract. (U.S. Air Force photo)

by engineering concerns. The Truman administration was still in post-WWII drawdown mode and was not inclined to spend money on new military hardware, and it was questionable whether the evolving Pratt & Whitney J-57 engine would be powerful enough to meet the range requirement of the contract. General Curtis LeMay was convinced that the J-57 would eventually produce the necessary thrust, and that the B-52 was what the Air Force needed. He convinced his colleagues that the model 464-67 was viable, and the two prototypes (XB-52 and YB-52) were built without a formal commitment for production of future bombers. The formal commitment came when Boeing was awarded a production contract for thirteen B-52As and seventeen detachable reconnaissance pods on 14 February 1951. The last major design change was made at General LeMay's insistence and included a conventional side-by-side cockpit, which increased the effectiveness of the copilot and reduced crew fatigue. Both of the XB-52 prototypes were too far along the production line to change, and they featured the original tandem seating arrangement with a framed bubble-type canopy, ala the B-47.

The YB-52, the second production XB-52 had with more operational equipment, but made the first flight of the B-52 on 15 April 1952 with "Tex" Johnston as pilot. Johnston was an experienced test pilot, having flown the Bell X-1 and P-59 while working at Bell Aircraft. He went to work for Boeing in 1948 and made the first flight of the XB-47. He would earn additional fame by performing a barrel roll over Lake Washington in the prototype 707. During ground testing on 29 November 1951, the XB-52's pneumatic system failed during a full-pressure test, resulting in an explosion that severely damaged the trailing edge of the wing. This resulted in the YB-52 flying first, in a two-hour, 21-minute proving flight from Boeing Field, to Larson AFB was undertaken with Boeing test pilot Johnston and air force Lieutenant Colonel Guy M. Townsend. After repairs, the XB-52 followed on 2 October 1952.

The B-52A

The Cold War heated up when North Korea invaded South Korea in June 1950. The United Nations approved action against this aggression (The Russians missed the meeting, and didn't get a chance to use their Member of The Security Council veto), and the United States was in a shooting war. The Air Force got serious about a new long-range bomber in 1951, and designated the B-52 the country's next intercontinental bomber, approving an initial production order for 13 B-52s. Only three of the 13 B-52As ordered were built, and all were returned to Boeing, and used in their test program. They were designated as Boeing model 464-201. The last of these (52-003) was eventually modified as the launch aircraft for the X-15 (and subsequently several other research vehicles) and designated NB-52A. Named "High and Mighty One", it served until 1969. It is currently displayed at the



The flight crew for the first flight of the XB-52 included noted test pilot "Tex" Johnston (right) (Boeing)

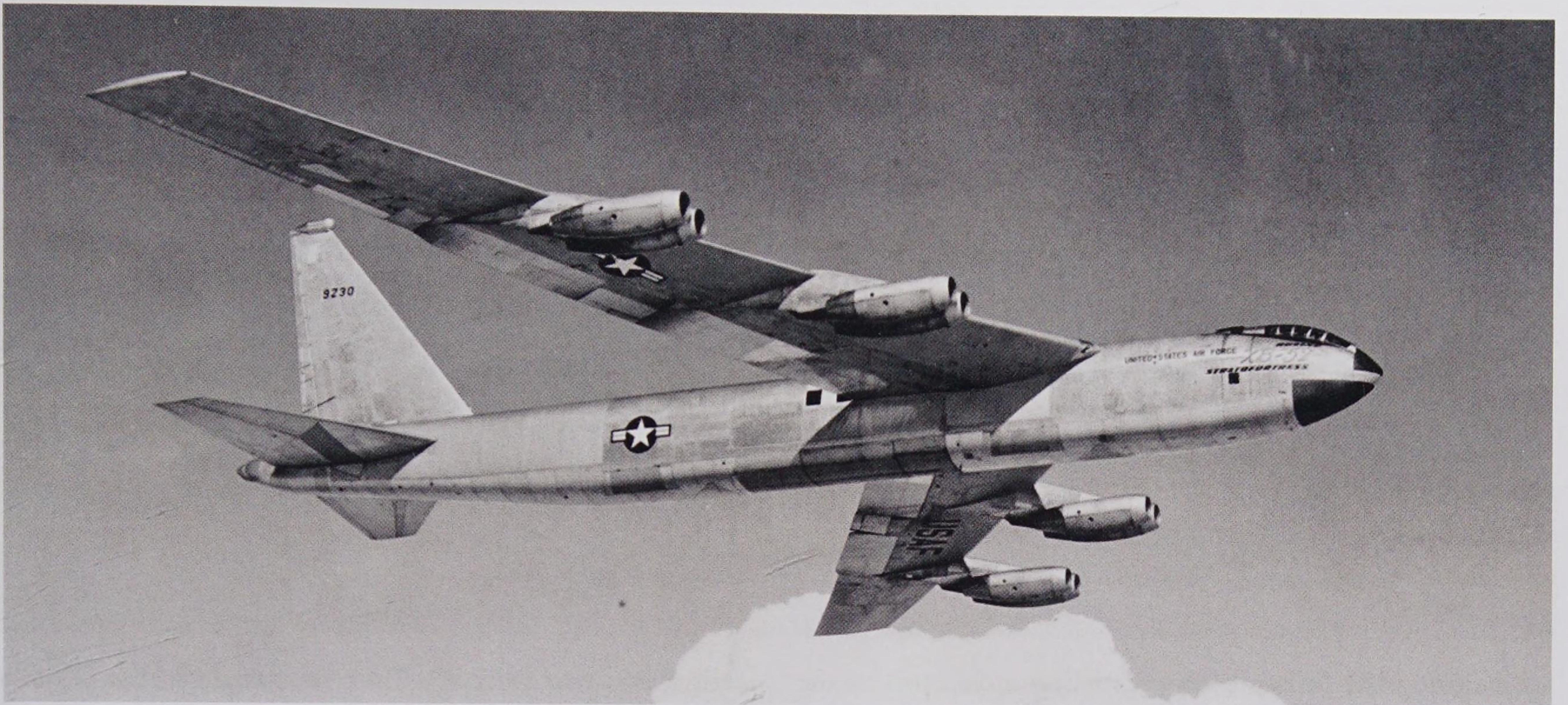
Pima air & Space Museum in Arizona. On 9 June 1952, the February 1951 contract was updated to order the aircraft under new specifications. The final 10, the first aircraft to enter active service, were completed as B-52Bs. At the roll out ceremony on 18 March 1954, Air Force Chief of Staff General Nathan Twining compared the B-52 to a leading edge weapon of an earlier age, when he said: "The long rifle was the great weapon of its day. ... today this B-52 is the long rifle of the air age."

The first B-52A flew Aug. 5, 1954. Boeing had tested the design with 670 days in the wind tunnel and 130 days of aerodynamic and aeroelastic testing, which resulted in a great flight test program. The air force was impressed and increased its order to 282 B-52s. After assembly of three B-52As, production converted to B-52Bs.

The B-52B

Ironically, the first large production run of what would become the most iconic long-range bomber in modern history began with the RB-52B. USAF planners had decreed that all B-52Bs would be built as pure reconnaissance aircraft, designated as Boeing model 464-201-1. Strategic Air Command was understandably disenchanted with this plan and asked that the RB-52Bs be configured with removable reconnaissance pods. The first order was for seventeen RB-52Bs, ten of which were originally begun as B-52As. An order for a further 43 RB-52Bs was signed on 15 April 1953. This was later changed to 13 RB-52Bs, 20 B-52Bs, with a further ten being completed as B-52Cs. The Stratofortress became operational on 29 June 1955, when 52-8711 was delivered to the 93rd Bomb Wing at Castle AFB, California.

Though visually similar to the B-52A, the B-52B featured a higher gross weight (up from 405,000 pounds to 420,000 pounds) and the more leading-edge MA-6A bombing/navigation system. The improved J57-P-29W engines upped thrust from 10,500 pounds to 12,100 pounds with water injection. Adding water to the fuel/air mixture



The XB-52 featured a tandem cockpit, ala the B-47. It was quickly abandoned in the interest of better crew coordination. (Boeing)

in a running engine may seem counter-intuitive, but adding water increases the mass being accelerated out of the engine, accounting for the increase in thrust. It also serves to cool the turbines, and since temperature is normally the limiting factor in turbine engine performance at low altitudes, the cooling effect allows the engine to be run at higher RPM with more fuel injected and more thrust created without overheating.

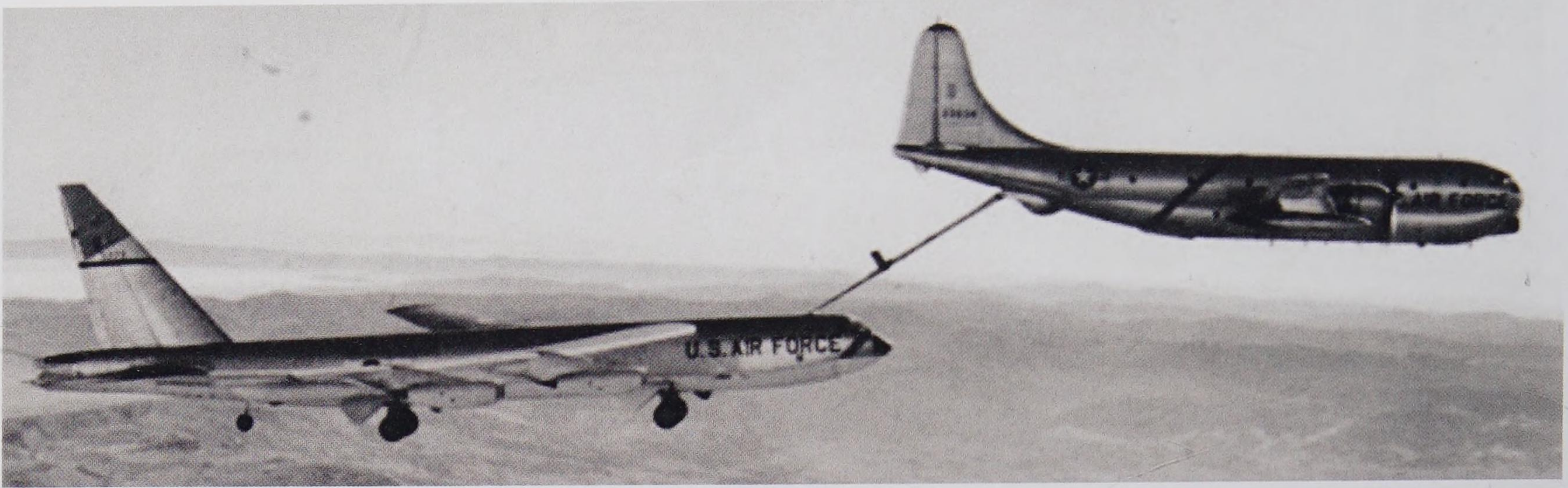
The defensive armament of the RB-52B was a pair of M-24A-1 20mm cannons with MD-5 fire control system, and this system was used on the first 16 B-52Bs. The final run of B-52Bs reverted to the original B-52 defensive system

of 4 M-2 50 caliber machine guns with the A-3A fire control system. Though many B-52Bs were upgraded and modified under Harvest Moon, Sunflower, Blue Band, and Quickclip programs, and most did receive the three High Stress modifications that strengthened their airframes, they were not modified for the low-level role which would become necessary when the threat of the SA-2 was brought home by the downing of Gary Powers' U-2.

The one and only JB-52B was modified for test work from RB-52B 52-004. Named "The Tender Trap" it served at the Air Force Flight Test Center at Edwards AFB and was



The XB-52 with the jet that ushered in the era of swept wing jet bombers, the B-47 Stratojet. (Boeing)



When the B-52 was introduced, the KC-97 was still a front-line tanker resource, but refueling from this relatively slow tanker required a deft touch as the B-52, with flaps and landing gear extended, hovered on the ragged edge as it took on fuel. (USAF)

used during the H-bomb drops on Eniwetok Atoll in the Marshall Islands.

The NB-52B was RB-52B 52-0008, named "Balls Eight", it was used as the drop ship for the X-15 and Lifting Body programs. It has been extensively modified over the course of its long career at NASA.

B-52B	Serial Numbers	Block Numbers
4	53-073/0376	B-52B-25-BO
8	53-0389/0387	B-52B-30-BO
11	53-0388/0398	B-52B-35-BO

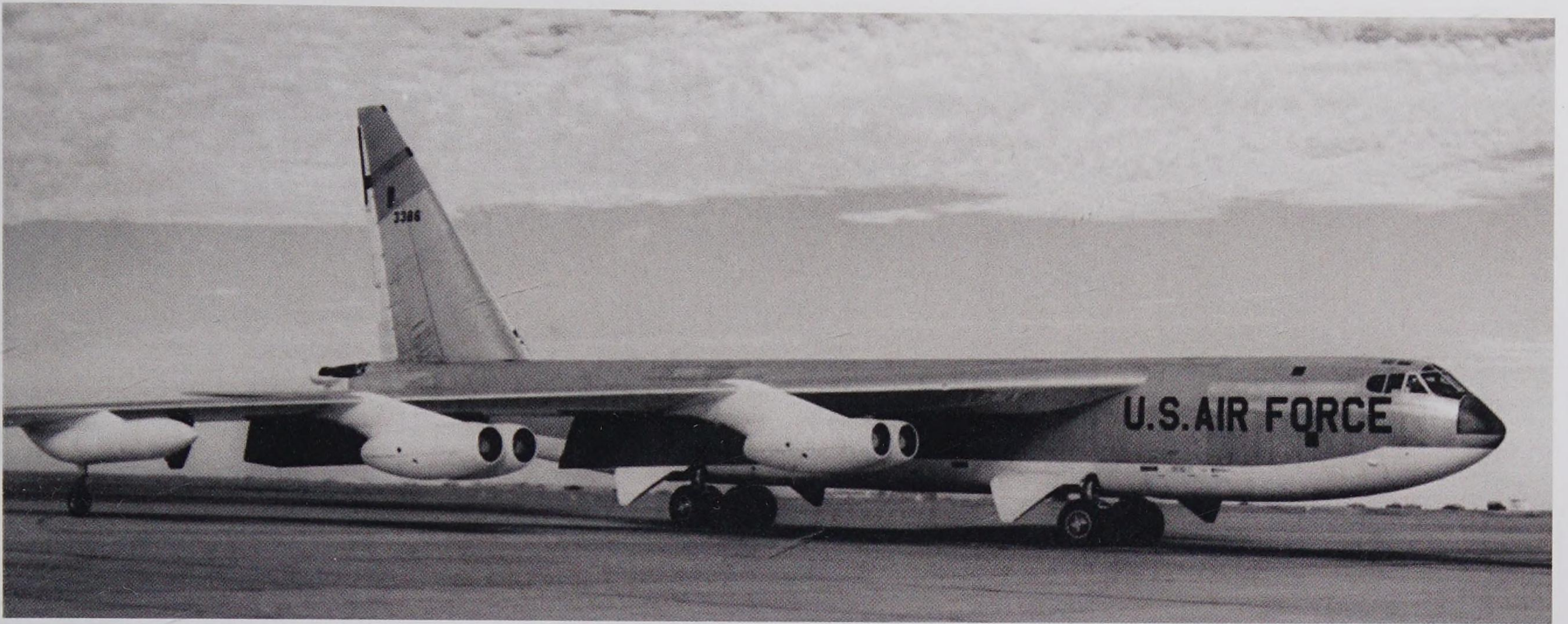
B-52C

In 1954, The modifications to the RB/B-52B became so numerous that it was decided that an all new aircraft

designation was necessary. The gross weight of the C model was upped to 450,000 pounds, due in no small measure to the replacement of the 1,000 gallon wing tanks with 3,000 gallon external tanks. Other improvements included the AN/ASB-15 navigation/bombing system, and the A-3A fire control system for the tail turret. This system would be used in all future tail gun systems on the B-52. Visual recognition of its nuclear bomber mission was introduced in 1956, when all B-52 undersides were painted in gloss white anti-reflective coatings to protect the bombers from the flash of the nuclear explosion.

The first flight of the B-52C was on 9 March 1956. The C model became operational that December with the 42nd and 99th Bomb Wings. B-52Cs were eventually modified with the newer AN/ASQ-48 and the A/A42G-11 auto flight control system, included the N-1 compass. The engines





of the C were the same used on the B. Performance figures for the C were: Maximum speed 636 mph at 20,200 feet, 570 mph at 45,000 feet. Cruise speed 521 mph. Stalling speed 169 mph. Initial climb rate was an impressive 5125 feet per minute. Service ceiling at combat weight was 45,800 feet. Some of the later C models were modified for the low level mission, including terrain-avoidance radar, improved radar altimeter, and beefed up airframes. Some were equipped with the Phase II ECM modifications, which were installed in all subsequent B-52s.

B-52C	Serial Numbers	Block Numbers
10	53-0399/0408	B-52C-40-BO
12	54-2664/2675	B-52C-45-BO
13	54-2676/2688	B-52C-50-BO

53-0399 and 54-2676 were later re-designated as JB-52Cs



Three B-52Bs of the 93rd Bomb Wing prepare to depart March AFB for Castle AFB, California, after their record-setting round-the-world flight in 1957.

and were used in test programs by the Air Force Flight Test Center and Boeing.

Throughout the 1950s, the B-52 chalked up many distance and speed records. It cut the round-the-world speed record in half, and in January 1962, flew 12,500 miles (20,117 kilometers) nonstop from Japan to Spain without refueling. This flight alone broke 11 distance and speed records. The 1950s also saw the introduction the jet airliner with the introduction of the Boeing 707. Boeing was destined to become the leader in the production of a long line of very successful jetliners, and these aircraft would be produced in Seattle, necessitating an additional B-52 production line. Boeing's Wichita plant, which had produced the B-29 and B-47 would become the prime B-52 outlet.

B-52D

The B-52D was the first large-scale production run of the B-52. 69 of the 170 D models were built in Seattle, the balance coming from the new line at the Boeing Wichita plant. The first B-52D flight was made by a Wichita-built D on 14 May 1956. (The first Seattle D model did not fly until September.) Beginning in 1959, all D models were modified for the low-level mission. Though the avionics mods were extensive, the structural mods were even more extensive and expensive. (Structural fatigue was at least 8 times higher in the bumpy air at the low-altitude flight profile, compared to the smooth air at altitude.) In the early 1960s, a three-phase High-Stress program was launched to counter structural fatigue, beginning when an aircraft had logged 2,000 flying hours. There were also additional programs, such as a 2,000-hour service life extension to select airframes in 1966–1968, and the extensive Pacer Plank reskinning, completed in 1977. The war in Vietnam created a new role for the B-52, that of a tactical bomber. The ability to carry a large load of conventional bombs meant that suspected enemy staging areas could be pulverized, and the B-52 began flying Arc Light missions



In November 1959, SAC initiated the Big Four modification program (also known as Modification 1000) for all operational B-52s except early B models. This was done to improve the aircraft's combat capabilities in the changing strategic environment, which recognized the SAM threat to high altitude penetration. The program was completed by 1963. The four modifications were the ability to launch AGM-28 Hound Dog standoff nuclear missiles (like those shown and ADM-20 Quail decoys, advanced electronic countermeasures (ECM) suite, and upgrades to perform the all-weather, low-altitude (below 500 feet or 150 m) interdiction mission in the face of advancing Soviet missile-based air defenses. (USAF)

in 1965, with B-52Fs flying from Andersen AFB on Guam, a round trip of approximately 5,000 miles. The B-52D was destined to carry the majority of the bombs in that war, and that was made possible by the "Big Belly" modifications made to the D models. Prior to Big Belly, the normal conventional war load was 27 500 pound or 750 pound bombs internally, with an additional 12 on the external wing pylons. The Big Belly mod increased that number 42 750 or 84 500 pounders internally. The use of high-density clips of bombs meant that no modification was necessary to the size of the bomb bay or bomb bay doors. In order to speed turn-around time, a system of preloading these clips was developed. At the same time the Big Belly mods were done, the modified Ds were repainted with black sides, belly and tail fin, with camouflage upper surfaces. (Black FS17038, SAC Bomber Green FS34159, Dark Green FS34079, and SAC Bomber Tan FS24201) Bombers so modified retained their ability to carry mines and/or nuclear weapons.

As the Soviet Union supplied Hanoi with more and more SAMs, it was felt prudent to give the B-52 additional ECM protection. From 1967 through 1969, the Rivet Rambler Phase V ECM was added to all SEA-assigned B-52Ds. The program included the AN/ALR-18 automated receiving set, AN/ALR-20 panoramic receiving set, AN/APR-25 radar

homing and warning set, AN/ALT6B or AN/ALT-22, AN/ALT-32H, AN/ALT-32L, AN/ALT-16 jammers, AN/ALE-24 Chaff dispensers, and AN/ALE-20 flare dispensers. This formidable array of defensive electronics made the B-52D the best-protected American bomber in the war. Eleven different B-52 wings flew combat in the Vietnam War, both as Arc Light bombers and in the climactic Linebacker II campaign. The D model was slated for retirement in the early 1970s, but its outstanding performance in the war earned it a reprieve, which included restoration of the nuclear mission and, from 1972 to 1977 Pacer Plank upgrades which strengthened wings and fuselage. Many of these bombers had exceeded their anticipated 5,000 hour airframe life limits by over 100%. SAC picked the best 80 of the remaining 128 D models and put them through a complete wings-off rebuild that included strengthening and re-wiring. This modernization resulted in added capability for a few of these bombers, including the ability to carry the GBU-15 glide bomb and a new digital avionics suite. Nevertheless, the D was headed for retirement and the last flight was made on 1 October 1983.

B-52D (Seattle) Serials	Block Numbers
21	55-0068/008 B-52D-55-BO
16	55-0089/0104 B-52D-60-BO



Base leadership and former North Dakota governor, William Guy, kneel in front of the “Peace Persuader” on Minot Air Force Base in July of 1961. This was the first B-52H Stratofortress delivered to the base. (USAF)

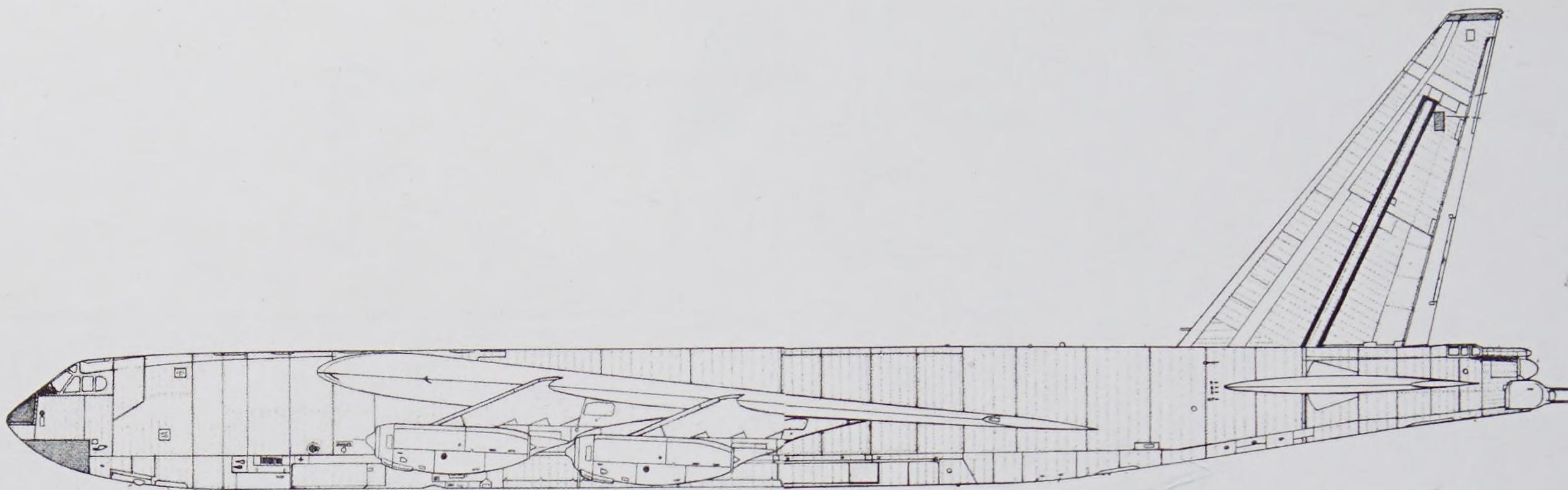
13	55-0105/0117	B-52D-65-BO
11	56-0580/0590	B-52D-70-BO
20	56-0591/0610	B-52D-75-BO
20	56-0611/0630	B-52D-80-BO

B-52D (Wichita) Numbers	Serials	B l o c k
3	55-0049/0051	B-52D-1-BW
3	55-0052/0054	B-52D-5-BW
6	55-0055/0060	B-52D-10-BW
4	55-0061/0064	B-52D-15-BW
6	55-0065/0067	B-52D-20-BW
5	55-0676/0680	B-52D-25-BW
12	56-0657/0668	B-52D-30-BW
12	56-0669/0680	B-52D-35-BW
18	56-0681/0698	B-52D-40-BW

B-52E

Visually, the B-52E was almost identical to the D model, but there were significant differences in other respects. The E was the first model built from the ground up as a low-level penetration B-52, and the systems received major upgrades in the form of the AN/ASQ-38 navigation system, the AN/ASB-4 bomb navigation system, the AN/APN-89A Doppler, MD-1 automatic astrocompass, and AN/AJA-1 true heading computer. The E model was never modified for conventional bombing, serving its entire career in SAC as a nuclear bomber. The first flight of the B-52E was 3 October 1957, and the last E model went to the Davis-Monthan “Boneyard” in 1970.

The first Seattle B-52E (56-0631) was assigned to the Air Force Flight Test Center and used for a wide variety of test programs. As a test airplane, it was designated NB-52E. One of the most important and consequential programs was the Load Alleviation and Mode Stabilization (LAMS) analysis. Low altitude flight was particularly fatiguing to the large B-52 airframe, and the LAMS program sought to quantify and alleviate these forces. Sensors were attached throughout the NB-52E and flight control computers were programmed to counter forces as they were encountered. As an adjunct to this program, a Direct Lift Control study was performed concurrently. The DLC used spoilers, ailerons and elevators to uncouple pitch from up and down movements, and then pitch and roll. An even more advanced program saw the NB-52E modified as a Control Configured Vehicle (CCV). The CCV NB-52E was modified with nose-mounted canards on either side and below the nose. Several new, computer-controlled, electronic control surfaces were installed. These programs showed significant possibilities, but were not taken beyond the experimental flight stages. Two B-52Es (56-0636 and 57-0119) were modified to test the General Electric TF-39 for the Lockheed C-5A “Galaxy” program and the JT9D for the Boeing 747. The TF-39 was mounted on the right inboard engine pylon in place of the two J57s normally installed. The single TF-39 turbofan, rated at about 40,000 pounds, had as much thrust as four J57 turbojets on a standard production B-52E. This eye-popping performance led to studies that conceived the B-52 modified with 2 or 4 TF-39s. Impressive though the possibilities were, the program never got beyond the “what if” stage.



B-52E (Wichita) Serials	Block Numbers
14	56-0699/0712 B-52E-45-BW
15	57-0095/0109 B-52E-50-BW
21	57-0110/0130 B-52E-55-BW
8	57-0131/0138 B-52E-60-BW

B-52E (Seattle) Serials	Block Numbers
19	56-0631/0649 B-52E-85-BO
7	56-0650/0656 B-52E-90-BO
9	57-0014/0022 B-52E-90-BO
7	57-0023/0029 B-52E-95-BO

B-52F

The B-52F was the last Stratofortress to be built with the original tall vertical fin and rudder. It was also the last of the line to be manufactured at both Boeing plants. First flight of the F model was on 6 May 1968. The most significant differences from previous models were the upgraded J-57-P-43W engines, which produced 13,750 pounds of thrust with water injection. One of the visual differences between the E and F was the bulge added to the left side of each engine pod,

which housed the hard drive alternators. Also added were cooling scoops for these alternators. The B-52F was used extensively in the war in Vietnam prior to modification of the D models to Big Belly configuration. The original internal conventional capacity of the F was augmented by programs South Bay and Sun Bath, which added the capability to carry 24 750 pound bombs on external wing pylons. When the Big Belly Ds became operational in the war zone, all of the Fs were withdrawn and reverted to the nuclear mission. The last F model was retired in 1978.

B-52F (Wichita)	Serials	Block Numbers
16	57-0139/0154	B-52F-65-BW
29	57-0155/0183	B-52F-70-BW

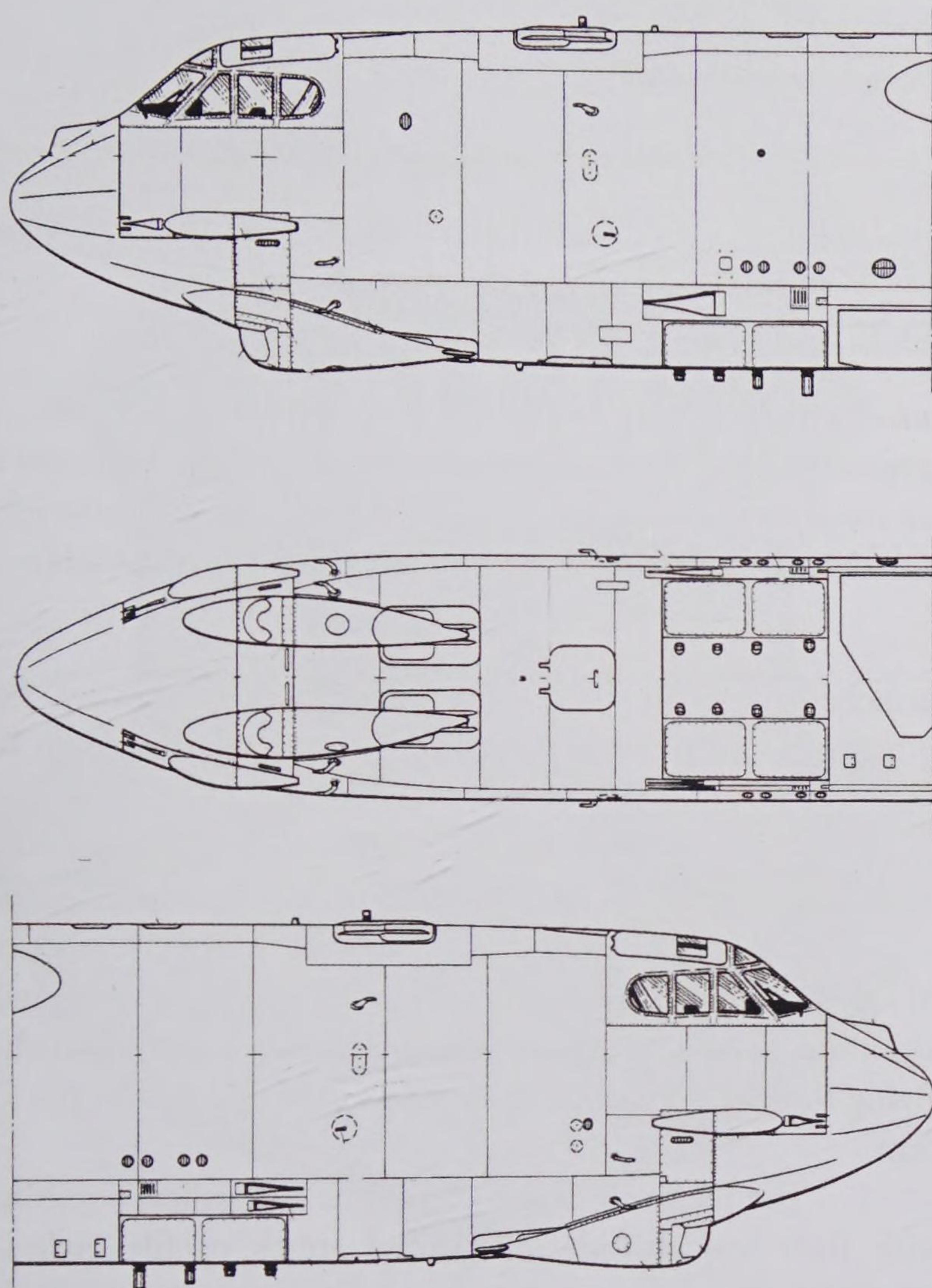
B-52F (Seattle)	Serials	Block Numbers
8	57-0030/0037	B-52F-100-BO
15	57-0038/0053	B-52F-105-BO
21	57-0053/0073	B-52F-110-BO

B-52G

The B-52G began life as a 1956 company project de-



B-52C 54-2672 of the 20th BS, 7th BW at Carswell AFB. USAF aircraft serials that were preceded with "0" (for "Obsolete") were applied older aircraft during the 1960s. (Ken Buchanan)



signed to augment the supersonic Convair B-58, which was on the cusp of entering service. The B-58 used J-79 fighter engines used in the F-104 and F-4, so the Boeing engineers proposed using the J-75 engines used in the F-105 and F-106. The company proposal, which included several other major improvements to the B-52F, was presented to Air Research and Development Command in March, 1956. USAF was impressed enough with this proposal to give Boeing a contract for further development work. The most significant improvement was the brand-new “wet” wing with integral fuel tanks which considerably increased the fuel capacity. This resulted in gross aircraft weight going up by 38,000 pounds compared with previous B-52 models. Adding to fuel capacity, a pair of 700 US gallon external fuel tanks was fitted under the wings. The new wing tanks were smaller than the 1,000 gallon tanks of the B-52F, but were thought to decrease wing upward bending moment at the wing tip and served as “anti-flutter” weights. The traditional ailerons were eliminated, replaced by spoilers on top of the wings which provided roll control, and the vertical tail was shortened by 8 feet. The water injection system capacity was increased to 1,200 US gallons, and the nose radome was enlarged with a new one-piece nose cone that replaced the two-pieces used on previous models. The tail gunner was relocated to the main cockpit and was provided with an ejection seat. From there he controlled the quad

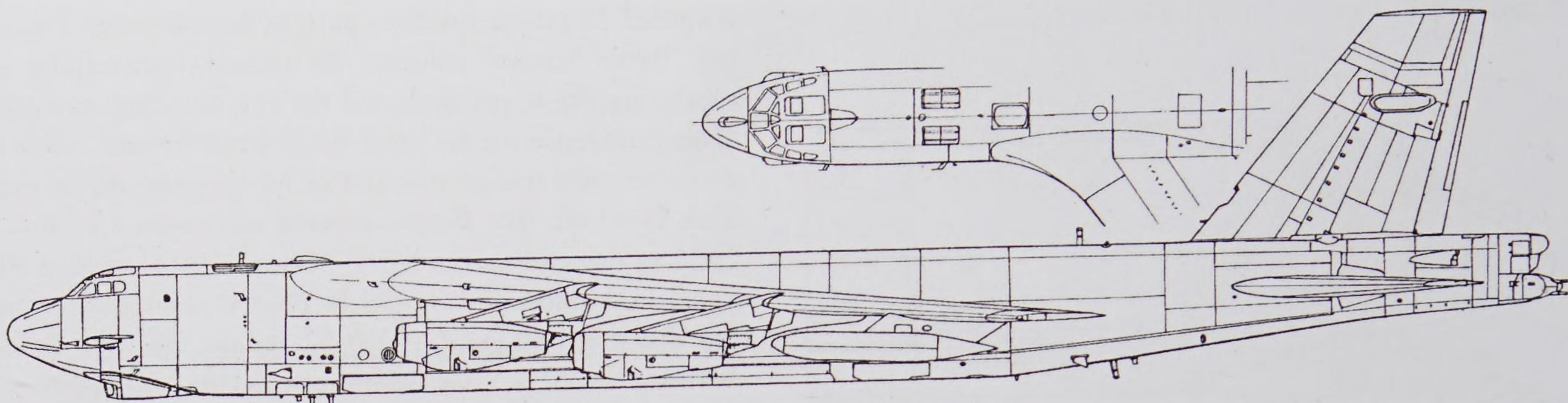
mounted 50 caliber machine guns of the tail turret. Dubbed the “Battle Station” concept, the offensive crew (pilot and copilot on the upper deck and the two bombing navigation system operators on the lower deck) faced forward, while the defensive crew (tail gunner and ECM operator) on the upper deck faced aft. The B-52G entered service on 13 February 1959 (a day earlier, the last B-36 was retired, making SAC an all-jet bomber force). 193 B-52Gs were produced, making this the most produced B-52 variant. All were built in Wichita. Most B-52Gs were destroyed in compliance with the 1992 Strategic Arms Reduction Treaty; the last B-52G, number 58-0224, was dismantled under New START treaty requirements in December 2013. A few examples remain on display for museums.

The wet wing introduced on G and H models was one of the most significant improvements in the B-52. Unfortunately the wet wings were even more susceptible to fatigue, experiencing 60% more stress during flight than the old wing. (A wet wing is a wing structure that is sealed and used as a fuel tank, instead of fuel bladder.) A wet wing can weigh less and the wing root bending moment caused by the lift generated by the wings in flight is decreased. This offers further reduction in weight by allowing structural components to be designed lighter as the components do not need to support larger forces. The decrease in weight adds performance improvements for high altitude profiles, but also increases the likelihood of fatigue at low levels. The wings were modified by 1964 under ECP 1050. This was followed by a fuselage skin and longeron replacement (ECP 1185) in 1966, and the B-52 Stability Augmentation and Flight Control program (ECP 1195) in 1967. Fuel leaks due to deteriorating Marman clamps continued to plague all variants of the B-52. To this end, the aircraft were subjected to Blue Band (1957), Hard Shell (1958), and finally QuickClip (1958) programs. The latter fitted safety straps that prevented catastrophic loss of fuel in case of clamp failure.

Some of the G models received the same Rivet Rambler ECM upgrades of the D models, and those assigned the role of conventional bomber were also equipped with wing pylon bomb racks. Those Gs which participated in Linebacker II sans Rivet Rambler protection carried AN/ALQ-119 ECM pods, but their lighter airframes could not sustain SAM damage like the D model, and 6 Gs were lost of North Vietnamese SAMs.

The threat of SAMs was well understood long before Linebacker II, and to keep the nuclear mission viable, long-range stand off weapons were developed for the B-52. The first of these was intended to allow the B-52 to attack enemy air defenses before coming into their lethal envelope.

The North American Aviation AGM-28 Hound Dog was a supersonic, turbojet-propelled air-launched cruise missile developed in 1959. The Hound Dog was first given the designation B-77, then re-designated GAM-77, and finally as AGM-28. It was supposed to be an interim weapon, used



Under the provisions of the SALT II treaty, aircraft carrying cruise missiles had to be readily identifiable as such by reconnaissance satellites. The AGM-86B-equipped B-52G was provided with nonfunctional wing root fairings known as "strakelets". The modification had to be visible to spy satellites to confirm the number of cruise missile-capable aircraft. It had to be made aerodynamically and structurally integral with the aircraft so that the change could not be quickly altered or moved from one aircraft to another.

until the GAM-87 Skybolt was available. When the Skybolt was cancelled, the Hound Dog continued in service for 15 years. It was eventually replaced by the AGM-69 SRAM and the AGM-86 ALCM. The AGM-69A Short Range Attack Missile (SRAM) contract was awarded to Boeing in 1966. After delays and technical flaws during testing, it was ordered into full production in 1971 and entered service in August 1972. SRAM had an inertial navigation system and a radar altimeter which enabled the missile to be launched in either a semi-ballistic or terrain-following flight path. The SRAM was also capable of performing one "major maneuver" during its flight which gave the missile the capability of reversing its course and attacking targets that were behind it, sometimes called an "over-the-shoulder" launch. The missile had a Circular Error Probable (CEP) of about 1,400 feet, but since it had a W69 nuclear warhead with a variable yield of 17 kilotons as a fission weapon, or 210 kilotons as a fusion weapon with Tritium boost enabled (The aircrew could turn a switch on the Class III command to select the destructive yield required), that CEP was considered more than acceptable. It had a maximum range of 110 nautical miles.

The AGM-86 missile is powered by an F107 turbofan engine that gives it high sustained subsonic speeds. It can be

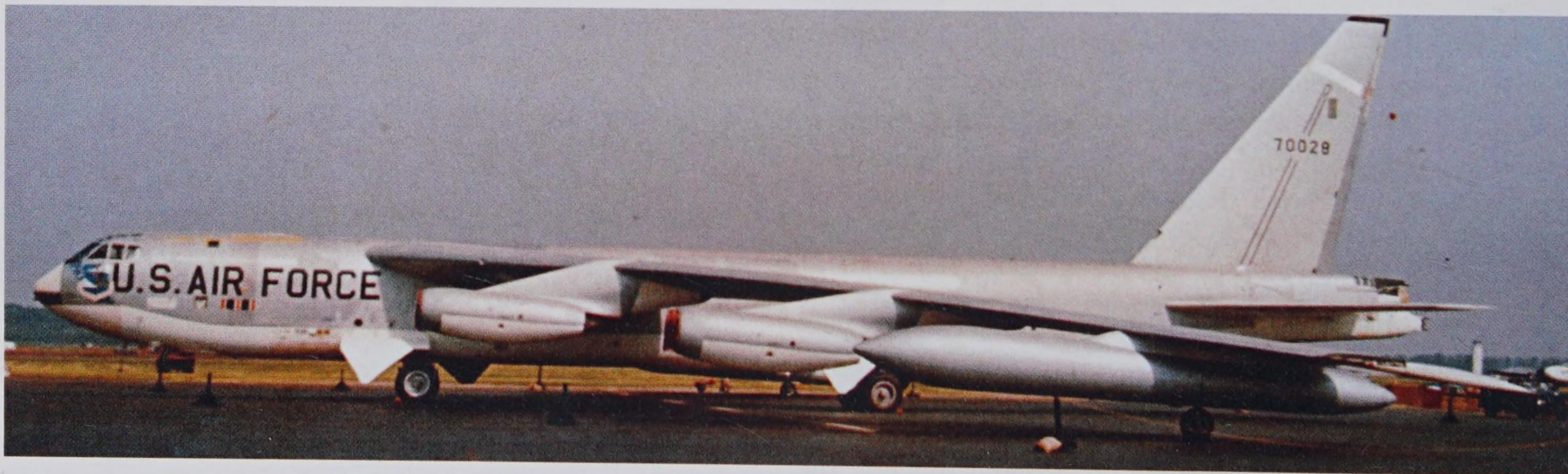
launched from aircraft at both high and low altitudes. Post launch, the missile deploys its folded wings, tail surfaces and engine inlet.

AGM-86B/C/D missiles increase flexibility in target selection. AGM-86B missiles can be air-launched in large numbers by the bomber force. B-52H bombers carry six AGM-86B or AGM-86C missiles on each of two externally mounted pylons and eight internally on a rotary launcher, giving the B-52H a maximum capacity of 20 missiles per aircraft.

The relatively small size of these missiles, combined with their low altitude and varied attack profile makes it tough for the enemy to sort them. These missiles are armed with nuclear warheads.

The AGM-86C/D CALCM, which is armed with a conventional warhead, has been used extensively in the war on terror and in Kosovo.

The B-52G got a nose job with the installation of the ASQ-151 Electro-Optical Viewing System (EVS) which provided the B-52G with additional sensors for low-level flight operations. The dated to the 1960s, when Boeing's chief of flight test, Jack Funk, had a Sony TV camera attached to the fin of a B-52. The improvised fit proved very promising, and



B-52E 57-0028 at Wright-Patterson AFB, Ohio in May, 1965. (Paul Stevens)



when Boeing's liaison to the USAF, Colonel Rick Hudlow, was told about the experiment, he passed it on to SAC. The result was award of a study contract in 1965, which lead to a production contract in 1970. A total of about 270 B-52Gs and B-52Hs were updated with the EVS between 1971 and 1976, at a total cost of \$281 million USD.

The EVS added two cheek blisters, with a Hughes AN/AAQ-6 forward looking infrared (FLIR) camera in the right blister and a Westinghouse AN/AVQ-22 low light level television (LLTV) camera in the left blister. The FLIR provided images from the heat of objects in the field of view, while the LLTV could pick up scenes illuminated only by starlight. The two imagers could be steered, and they could be rotated backwards in their blisters to protect them when not in use.

The EVS included new cockpit displays that provided imagery from the cameras and also displayed flight status information. EVS made low-level operations much easier and safer, and it reduced the aircraft's vulnerability against enemy defenses, since the sensors allowed the bomber to be flown without use of navigation radars, whose emanations could be tracked by the enemy. It also allowed the Bu-52 to be flown when it was buttoned up with flash curtains for a nuclear strike.

The Rivet Ace Phase VI ECM Defensive Avionics Systems upgrade was made near the end of the EVS up-



Airmen from the 36th Expeditionary Aircraft Maintenance Squadron, deployed from the 96th Expeditionary Aircraft Maintenance Unit, Barksdale Air Force Base, La., load a training AGM-86C Conventional Air-Launched Cruise Missile during a B-52 load demonstration. The aircraft was loaded with several training CALCMs to show the capabilities of the 96th EAMU load team. (U.S. Air Force photo by Senior Airman Benjamin Wiseman)

grade. It included a comprehensive update of countermeasures systems for the B-52G and B-52H which included An AN/ALQ-117 active countermeasures set, with antennas in fairings alongside the nose and in a pop-up antenna mounted above the tail, AN/ALR-20A wideband countermeasures receiving set, with antennas littered all over the aircraft. (The "20 Scope" is the primary tool for detecting and analyzing threats.), AN/ALR-46(V) digital radar warning receiver, AN/ALQ-122 false target generator system, AN/ALT-28 jamming transmitter, with the antenna fitted in a fairing on top of the nose, replacing five earlier ALT-series jammers, AN/ALQ-153 tail-warning radar set, AN/ALT-32H high-band jamming sets, AN/ALT-32L low-band jamming sets, Two AN/ALT-16A barrage jamming transmitters, driven by the AN/ALQ-122, Twelve AN/ALE-20 flare dispensers, with a total of 192 flares, and Eight AN/ALE-24 chaff dispensers, with a total of 1,125 bundles of chaff.

The ECM enhancements led to the extension of the tail behind the tailplanes by 40 inches. A "Phase VI+" ECM update would be installed beginning in 1988, with the main change being the replacement of the AN/ALQ-117 with the improved AN/ALQ-172(V)2 countermeasures system. Another major upgrade of the B-52 was begun in 1985, when all B-52Hs and a number of B-52Gs were fitted with the Norden "AN/APQ-156 Strategic Radar system, replacing the AN/AQS-176 unit, which had replaced the AN/ASQ-38 BNS.

The G model was the only version of the B-52 to take part in Operation Desert Storm. About 80 B-52Gs operated against Iraq from bases in the US and forward locations, including Jeddah, Saudi Arabia, Moron, Spain, RAF Fairford in the UK, and Diego Garcia in the Indian Ocean. They carried the new gunship grey camouflage into combat.



The war kicked off on 17 January 1991, when seven B-52Gs took off from Barksdale AFB in Louisiana. Their flight lasted 35 hours and took them almost halfway around the world to launch 35 CALCMs before RTB. It set a record for longest-distance combat mission. The routes of the missiles were planned so that they would impact almost simultaneously, and 33 of them hit their assigned targets. That same day, the B-52G followed up this strike with the first low-level attacks conducted by the type after decades of training. The B-52G attack profile was at 300 feet, hitting four airbases and a highway.

Within a few days, the Iraqi air defense network had been degraded to the point that high-altitude bombing could be resumed, with three-ship cels of B-52s pounding

Iraqi troop concentrations in Iraq with 750 pound bombs and cluster bombs. The B-52 performed 1,600 sorties in the Gulf War and dropped 22,725 tons of munitions.

No B-52s were lost in action, but one B-52 crashed in the Indian Ocean on the way back to Diego Garcia after an electrical system failure, with the loss of three crew members. Two other B-52Gs were hit by Iraqi SAMs, and one was unlucky enough to be hit by a US "high-speed anti-radiation missile (HARM)". The HARM had been fired at an Iraqi radar that then went silent, whereupon the HARM locked onto the tail radar of a B-52G and hit the bomber. (That jet was subsequently named In HARM's Way.) All three of these aircraft made it safely back to base.

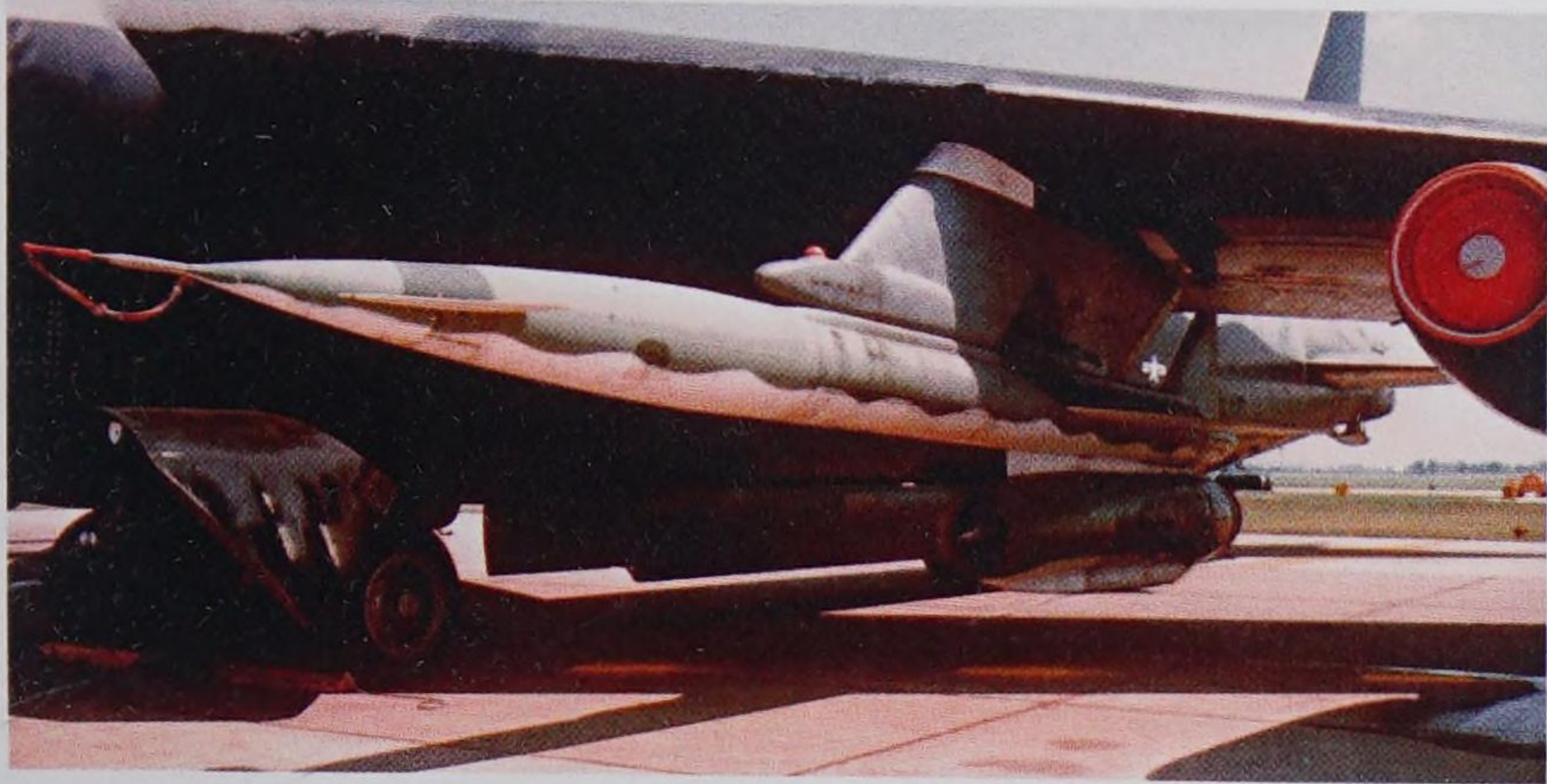
B-52G (Wichita)

Serials

B l o c k



B-52G of the 60th Bomber Squadron during Exercise Harvest Coconut in 1984. The 60th stood nuclear alert between 1959–1971 with the B-52G, equipped with the AGM-28 Hound Dog cruise missile. It was reassigned to Andersen AFB, Guam in 1971 and reassigned to the 43d wing and re-equipped with the B-52D, configured for conventional bombing. From Andersen AFB, the squadron engaged in combat operations, flying Arc Light, Linebacker I and Linebacker II bombing missions over North Vietnam until 1973. The 60th remained on alert after the Vietnam War on Guam; re-equipped with B-52Gs in 1983. They remained on alert throughout the balance of the Cold War, but were inactivated in 1990. (USAF by Staff Sgt. B. Zimmerman)



Operational Hound Dogs eventually acquired the same SAC camouflage as their nuclear bomber carriers. Seen here mounted on a B-52D at Blytheville AFB in 1974. (author)

Numbers

8	57-6468/6475	B-52G-75-BW
10	57-6476/6485	B-52G-80-BW
14	57-6486/6499	B-52G-85-BW
21	57-6500/6520	B-52G-90-BW
30	58-0158/0187	B-52G-95-BW
24	58-0188/0211	B-52G-100-BW
21	58-0212/0232	B-52G-105-BW
14	58-0233/0246	B-52G-110-BW
12	58-0247/0258	B-52G-115-BW
12	59-2564/2575	B-52G-120-BW
12	59-2576/2587	B-52G-125-BW
15	59-2588/2602	B-52G-130-BW

B-52H

The last production version was the B-52H (Model 464-261) All were manufactured in Wichita. The B-52H is the only version of the Stratofortress still flying, and plans are for it to continue to fly until at least 2028.

There were two separate B-52H contracts. Letter Contract AF33(600)-38778 was signed on 6 May 1960 and covered 62 aircraft with FY 1960 funds. The second contract was AF33(600)-41961, signed on 28 June 1960, but not finalized until late 1962.

The biggest difference between the B-52H and earlier versions was the replacement of the water-injected J57 turbojet engines by Pratt & Whitney TF33-P-3 turbofans. The TF33 was a military adaptation of the JT3D turbofan, which had originally been produced as an adaptation of the J57 to the commercial market. The TF33 engines of the B-52H offered 30 percent more thrust than the J57s of the G-model, even when the J57s were using water injection. A maximum thrust of 17,100 pounds could be delivered, producing much better airfield performance and an extra margin of safety during heavyweight takeoffs. The H model had a ground roll of 500 feet less than that of the B-52G.

The TF33 was also much cleaner and quieter when operating at full power. It was cleaner because it did not leave the huge clouds of black smoke associated with the J-57 and,



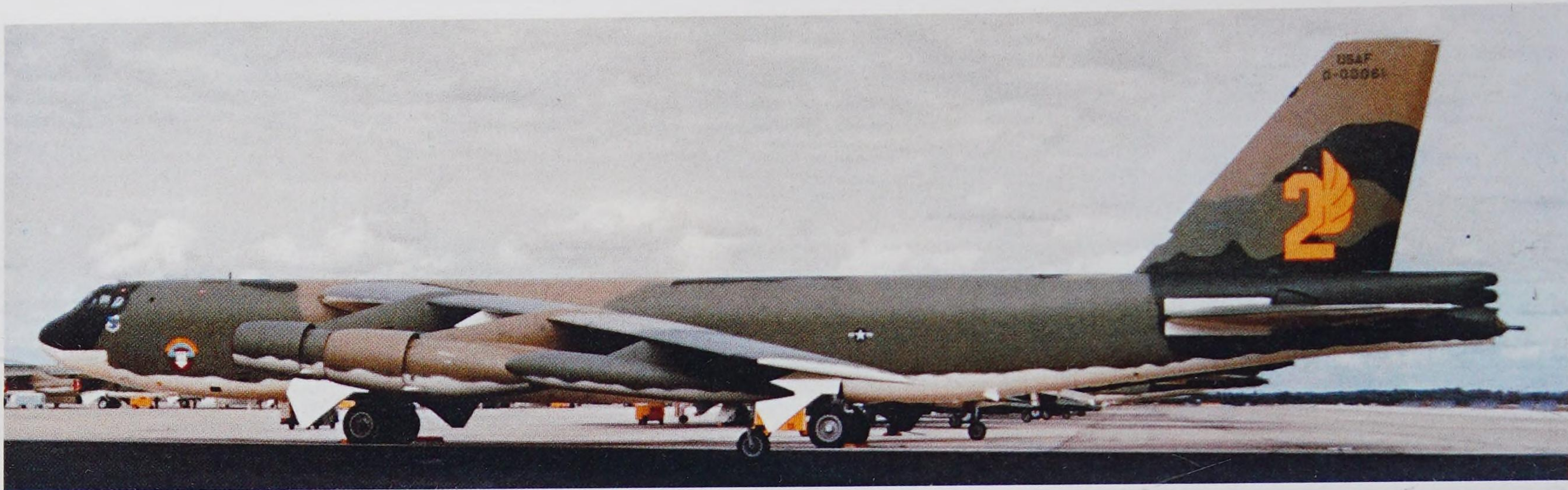
(left) B-52G crew scrambles to their Hound Dog-armed alert bird during a practice nuclear alert. (USAF)

like all turbofans, the TF33 engine is much quieter. The deletion of the water injection also alleviated the necessity to maintain large stocks of (prepositioned) distilled water (required for the water injection systems of the J-57) at forward bases.

The TF33 was also much more economical, which translated to a notable improvement in range. Combat radius of the B-52H was 4176 nautical miles with a 10,000 pound bomb load, compared to 3550 nautical miles for the B-52G. The TF33 also had a much quicker throttle response than the J57. B-52 pilots, who were accustomed to the more modest acceleration of the J-57s, were surprised when their rapid a movement of the throttles caused the aircraft to pitch up at a rate beyond the available elevator authority to correct the excessive pitch. This was also aggravated by fuel slosh--the fuel in the wet wing rushing to the rear of the wing during acceleration and moving the center of gravity aft. In order to prevent this from happening, mechanical thrust gates were added to the throttle quadrant. These thrust gates can be positioned for any maximum thrust desired--once set the pilot cannot inadvertently jam the throttles forward and get more thrust than desired. Air refuelling capability was improved by altering the spoiler positions so that the outward segments could extend up about ten degrees, making small lateral corrections possible without inducing pitch-up.

The TF-33 engines were not without their teething problems. There were difficulties with throttle creep, hard or slow starting, flameouts, and uneven throttle alignment. The engine consumed too much oil, turbine blades frequently failed, and inlet cases often cracked. The Hot Fan program was begun in mid-1962 to correct these problems and to increase the reliability of the TF33. The Hot Fan project was interrupted by the Cuban Missile Crisis of October 1962, when all Stratofortresses had to stand alert, and was not resumed until January 1963. The project was completed by the end of 1964.

Starting in January 1963, a pair of cartridge starters were installed in every B-52, in an attempt to make it possible to start the engines faster and get the Stratofortress airborne



B-52H-160-BW of the 379th Bomb Wing, 524th Bomb Squadron at Wurtsmith AFB, Michigan. In 1977, the 524th exchanged their B-52Hs for the conventional bomb capable B-52G. The squadron deployed aircraft and personnel to Prince Abdullah AB in Jeddah, Saudi Arabia. These planes were part of the 1708th Bombardment Wing (P), a provisional wing formed from B-52Gs out of Barksdale, Castle, Wurtsmith, and others. The planes arrived at dawn on the first day of the air war. One plane flew 29 missions out of Jeddah, the most of any bomber crew in the theater. During the Gulf War, 524th squadron aircraft carried the "Triangle K" tail flash in honor of their World War II predecessors and heritage. The 524th was inactivated on 15 June 1993. (Ken Buchanan)

when the alert horn sounded. (Cartridge starters had been used in several different fighters for years.) This also allowed for operation from forward locations that might lack ground power units. The installation of this equipment reduced the reaction time by about two minutes, but the Air Force was still not satisfied with the speed with which its B-52 force could get off the ground, so in 1974 project Quick Start added a cartridge starter to every engine on the B-52G and H models. This allowed simultaneous start of all eight engines and greatly reduced the amount of time required before the aircraft could get airborne.

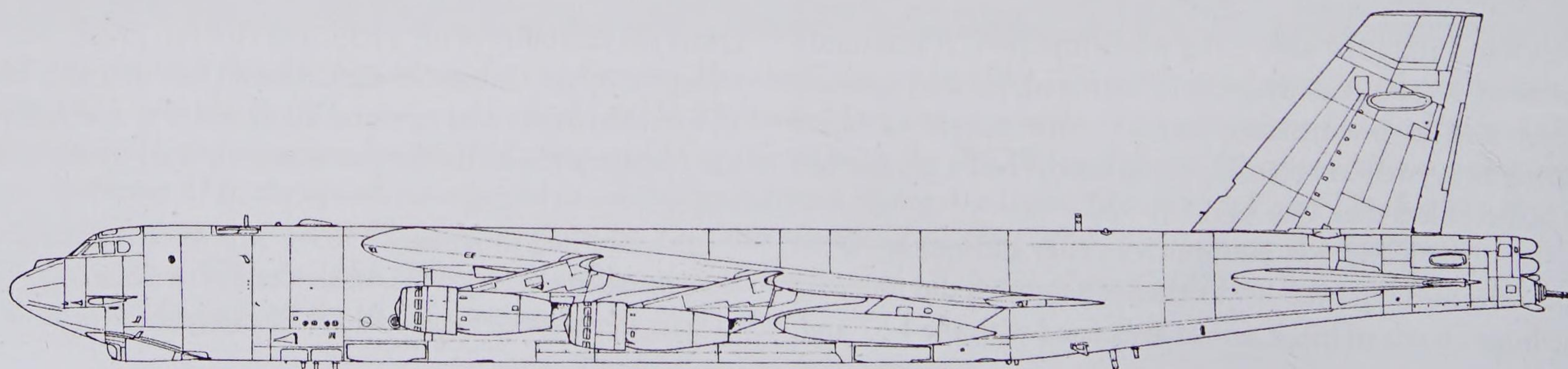
Advances in engine technology have led to proposals to re-engine the B-52H with more modern fan jets. Boeing suggested re-engining the B-52H fleet with the Rolls-Royce RB211 535E-4. This would involve replacing the eight Pratt & Whitney TF33s (total thrust $8 \times 17,000$ lb) with four RB211s (total thrust $4 \times 37,400$ lb)—which would increase range and reduce fuel consumption, at a cost of approximately US\$2.56 billion for the whole fleet (71 aircraft at \$36 million each). A Government Accountability Office (GAO) study concluded that Boeing's estimated savings of \$4.7 billion would not be realized and that it would cost \$1.3 billion over keeping the existing engines, citing significant up-front procurement and re-tooling expenditure, as well as

the RB211's higher maintenance cost. The GAO report was subsequently disputed in a Defense Sciences Board report in 2003, and the Air Force was urged to re-engine the aircraft without delay. Further, the DSB report stated the program would have significant savings, reduce greenhouse gas emissions, and increase aircraft range and endurance. These were also the conclusions of a separate Congressional-funded study conducted in 2003. The re-engining studies are on-going, but to date, no decision has been made.

The quad-mounted 50 caliber machine guns were replaced by a single General Electric M61 Vulcan 20-mm cannon, with 1242 rounds of ammunition. The carried 1242 rounds of ammunition. The Emerson AN/ASG-21 fire control system was installed as standard. The Battle Station seating remained the same as that of the G model.

As the ultimate Stratofortress, the H model has undergone continuous upgrading to allow for delivery of evermore sophisticated weaponry. The list of weapons is extensive.

The bomb bay of the B-52H is 28 feet long and 6 feet wide. It is enclosed by double-pane doors. Three interconnected and hydraulically-activated sections on each side are opened to release the weapons. The B-52H can carry two four-bomb or up to three nine-bomb clips internally. Conventional internal B-52 loads include 27 each of SUU-30H/B (CBU-52, -58,





The primary, and most recognizable, difference between the B-52G and the B-52H are the TF-33 turbofan engines of the H. The differences are evident in appearance, which is why no further recognition mods were necessary for nuclear missioned H models under the terms of the SALT II treaty. Here, Staff Sgt. Ben Norton works to regenerate a B-52 Stratofortress on 8 December 2009, at Barksdale Air Force Base, La. Airmen work around the clock at a “forward operation” during an operational readiness inspection to determine the ability to rapidly deploy assets and personnel. Sergeant Norton is assigned to the 2nd Aircraft Maintenance Squadron. (U.S. Air Force photo/Staff Sgt. Sarah E. Stegman)

and -71), Mk 82 500-lb conventional or High Drag bombs, MK 36 500-lb destructor bombs, Mk 59 or 62 500-lb Quickstrike mines, or M117 750-pound bombs (conical fin, destructor, retarded, or air inflatable retard); 18 each of MJU-1B countermeasures sets or M129 leaflet dispensers; 12 each of Mk 52 2000-pound mines; six each of CBU-87 combined effects munitions or CBU-89 Gator. Alternatively a clip of 8 Mk 84 2000-lb bombs, Mk 41 2000-lb destructors, Mk 55 2000-lb bottom mines, Mk 56 2000-lb moored magnetic mines, Mk 60 2360-lb captive torpedoes (CapTor), Mk 64 or 65 2000-lb Quickstrike mines, or AGM-86C cruise missiles can be carried inside the bomb bay. A pair of 9-megaton B53 thermonuclear weapons can also be carried inside the bomb bay.

Two types of external pylons can be fitted underneath the wings of the B-52H. The longer one was originally used for carrying the AGM-28 Hound Dog cruise missile, while the shorter “stub” wing pylon was designed for conventional weapons loads.

The stub wing pylon is only compatible with aircraft that were not modified to carry ALCMs. The short pylon was originally fitted with the I-beam rack adapter, which could carry up to 12 weapons on each pylon. Two MER-1-6 or -6As are attached. Among the weapons that can be carried were 24 each of the SUU-38H/B dispenser (CBU-52, -58, and -71 units), CBU-89, Mk 82 500-lb bombs (conventional or Snakeye retarded), Mk 36 500-lb Destructor bombs, Mk 59 or Mk 62 500-lb Quickstrike mines, M117 750-lb bombs (conical fin, retarded, and Air inflatable retard), MC-1 chemical dispenser, CBU-72, Mk 20 Rockeye II cluster bomb

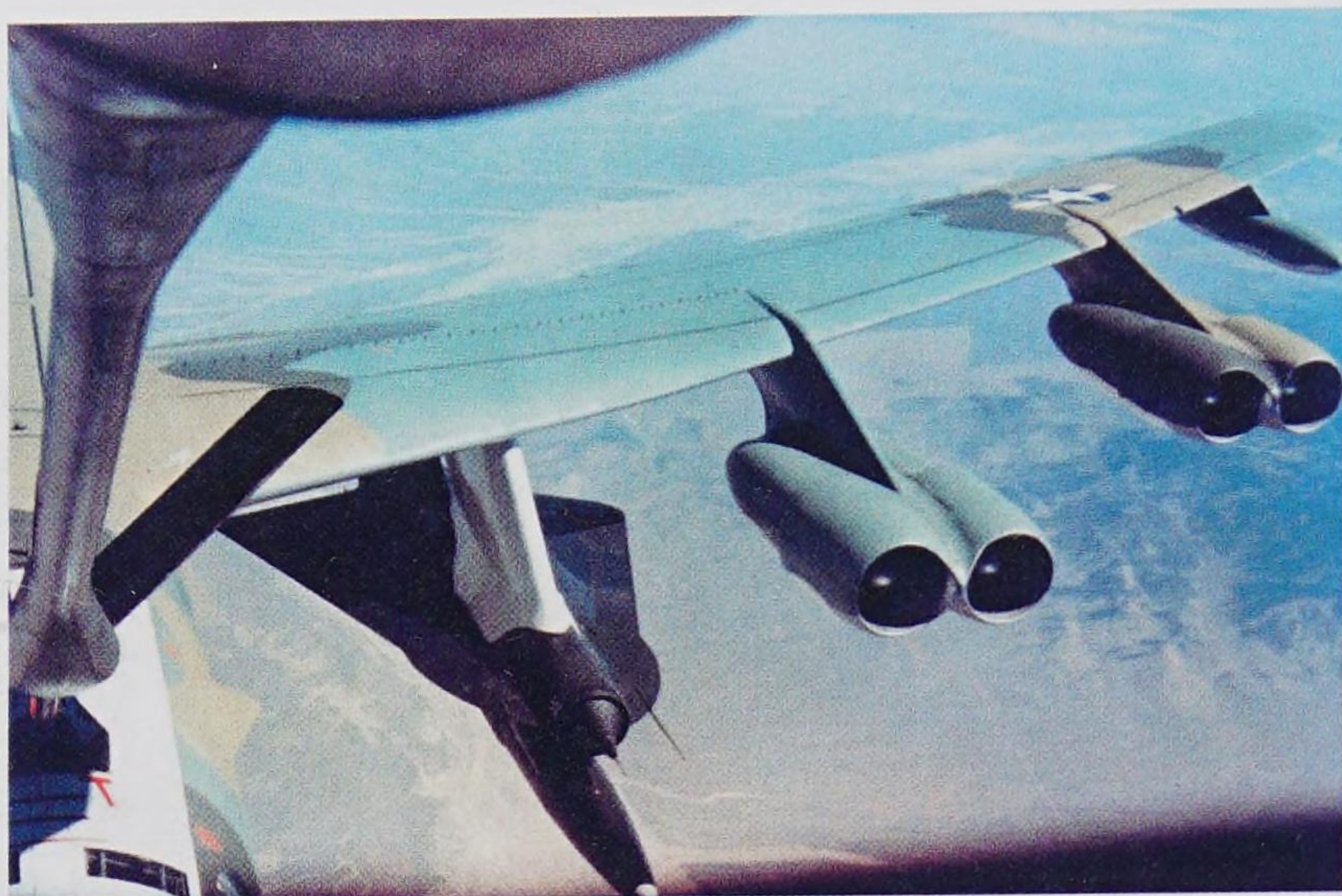
units, or M129 leaflet dispensers. Because of store weight, only 22 CBU-87 Combined Effects Munitions units can be carried, with the aft center station on the forward left MER and the forward center section of the aft right MER being empty. Normally, only one type of bomb is carried per mission. When 8 weapons are carried, they are mounted on the forward and aft shoulder stations only. When 10 weapons are carried, they are mounted on the forward and aft shoulder stations and on the center middle station. When 12 weapons are carried, they are mounted on the shoulder stations only.

The B-52H also carried the AGM-69 Short-Range Attack Missile (SRAM) and the Boeing AGM-86 Air Launched Cruise Missile (ALCM). The B-52H could carry a total of 12 AGM-86B missiles on underwing pylons. The unratified SALT II agreement stipulated that no more than 130 ALCM bombers could be deployed by the USAF. The delivery of the 131st ALCM-capable aircraft (B-52H serial number 60-0055, appropriately named Salt Shaker) on November 28, 1986 was a technical violation of this treaty. Eventually, a total of 194 Stratofortresses were converted into ALCM launchers. Unlike the B-52G, which required the “strakelet” mod to identify ALCM aircraft, the B-52H was easily recognized by its turbofan engines, so no special modifications were needed to make it comply with the provisions of SALT II.

The B-52H can carry eight more AGM-86B missiles internally in a Common Strategic Rotary Launcher (CSRL), which gives B-52H up to 20 AGM-86B cruise missiles (8 on the CSRL, plus six each on the underwing pylons). The CSRL program started in 1988. The rotary launcher is fitted inside the bomb bay and is attached to yokes. New electrical and hydraulic lines were fitted inside the bomb bay to operate and control the launcher. The launcher and its associated systems weigh approximately 5000 pounds. Alternatively, the CSRL can carry as many as four B28 70-350 kT nuclear bombs or as many as eight B61 (10-500 kiloton yield) or B83 (1-2 megaton yield) nuclear bombs. 82 of the B-52Hs were provided with CSRL capability, which is not compatible with either the B-1 or the B-2 bombers.

The Jolly Well program modified major components of the AN/ASQ-38 bomb/navigation system originally fitted to the B-52E to H models. These mods included engineering changes to improve low-level terrain avoidance capabilities. The Jolly Well program was completed in 1964, after mods to 480 B-52s.

Under Senior Bowl, a pair of B-52Hs (60-0021 and 60-0036) were modified to carry a D-21B reconnaissance drone underneath each wing between the inboard engines and the fuselage. The D-21 had been designed to be carried by an earlier version of the SR-71, the A-21. After four successful launches by the A-21, the 4th attempt resulted in the loss of the D-21 and A-21 when the drone hit the tail of the A-21. After that, the designer of the D-21, Kelly Johnson, suggested that B-52s could be modified to carry the drone. Four operational missions with the D-21B took place under



A D-21 drone mounted under the wing of a B-52H.

the codename Senior Bowl. These were conducted over the People's Republic of China from 9 November 1969 to 20 March 1971 to spy on the Lop Nor nuclear test site. The USAF's 4200th Support Squadron, based at Beale Air Force Base, California, flew the missions, usually from Andersen Air Force Base in Guam.

The Chinese never spotted the D-21B, but it failed to turn around and continued straight on, crashing somewhere in the Soviet Union. Another test flight was conducted on 20 February 1970 in a successful attempt to correct any problems. The second operational mission was 16 December 1970. The D-21B made it all the way to Lop Nor and back to the recovery point, but the hatch had a partial parachute failure and was lost at sea.

During the third operational mission, on 4 March 1971, the D-21B flew to Lop Nor and returned, jettisoning the hatch. It deployed its parachute, but the midair recovery failed. The destroyer that tried to retrieve the hatch from the water ran it down and it sank. The fourth, and last, flight of the D-21B was on 20 March 1971. It was lost over China on the final segment of the route.

On 23 July 1971, the D-21B program was canceled, due to the poor success rate, the introduction of a new generation of photo reconnaissance satellites, and President Richard Nixon's diplomatic efforts with China.

The B-52 had begun life in the analog age, but by the mid-1970s, the digital age was upon us and the AN/ASQ-38 bombing/navigation equipment in the B-52G and H were increasingly prone to malfunctions. The Air Force realized they needed a replacement, since the B-52 itself seemed ageless. The AN/ASQ-176 Offensive Avionics System (OAS) was installed in the 1980s. The system made extensive use of digital technology, and incorporated a Mil-Std-1553A digital databus, a new radar altimeter, an attitude heading reference system, an inertial navigation system, and missile interface units and major modifications to the primary attack radar. The five functional subsystems are: interface, controls and display, computational, navigational, and weapons delivery. These are composed of the AN/AYK-17 digital data set, AN/

ASQ-175 control-display set, AN/AYQ-10 ballistics computer set, AN/ASN-136 inertial navigation set, AN/APN-224 radar altimeter, AN/ASN-134 attitude heading reference system, AN/APN-218 Doppler radar, OY-73/ASQ-176 radar set group, AN/AWQ-3 control monitor set, RO-521/ASQ-176 video recorder, and FCP tape recorder. The mission tapes fed the flight plan into the system at the beginning of the mission. The new system was considerably more reliable than the AN/ASQ-38 which it replaced, and was configured for low-level use and was hardened against electromagnetic pulse effects. These modifications were completed in 1986. In 1985, work was begun on replacement of the ASQ-176 unit in all B-52Hs by the Norden AN/APQ-156 Strategic Radar, which incorporated synthetic aperture technology. This meant new controls and displays and a new antenna electronics unit and an improved radar processor.

In 1991 the gunner's station was removed, which cut the crew complement to five. The gunner's ejection seat was retained, and is now be occupied by an instructor or flight examiner. (Who are very grateful they no longer have to sit on a jump seat, and wait for one of the lower deck ejection seats to fire, so they can fall out of that hole and open their parachute manually when the abandon aircraft command is given.) The M61A1 Vulcan 20-mm cannon in the tail was taken out and the gun opening was covered over by a perforated plate. The wiring and instruments associated with the gun were all retained so that the gun could in pr be reinstalled, even though there are no longer any trained gunners available to shoot it. In 1994 Conventional Enhancement Modification (CEM) program was initiated. CEM was designed to give the B-52H an improved capability for conventional warfare. During the early 1990s, the USAF had planned that the B-52G would perform the conventional and maritime mission, (which it did in Operation Desert Storm) with the B-52H being assigned to the nuclear standoff role. When the G models were retired, the B-52H had to be able to take over its conventional warfare mission. The process was begun with the addition of AGM-142A and Harpoon capability to the B-52H. This was done by adding the Heavy Stores Adapter Beam (HSAB) to the underwing weapons pylon. The HSAB, which was originally fitted to the B-52G, made it possible to carry up to nine large weapons on each pylon externally. A Global Positioning System (GPS) navigation system was added, with receivers located at the offensive station. An AN/ARC-210 VHF/UHF radio with secure voice encryption capability was added, and Have Quick II anti-jam features were added to the UHF wavelengths available at the pilots and offensive stations. SINCGARS anti-jam/secure capability was added for VHF communications. The Military Standard 1760 databus was added to prepare the B-52H for a new generation of weapons not yet in the inventory such as the Joint Direct Attack Munition (JDAM), the Joint Stand-Off Weapon (JSOW), and the Wind-Corrected Munitions Dispenser (WCMD). From 2 to 3 September 1996, two B-52H bombers conduct-

ed a mission as part of Operation Desert Strike. The B-52s struck Baghdad power stations and communications facilities with 13 AGM-86C conventional air-launched cruise missiles (CALCM) during a 34-hour, 16,000-mile round trip mission from Andersen AFB. This B-52 mission again broke the record for the longest distance ever flown for a combat mission. Since the mid-1990s, the B-52H has been the only variant remaining in military service.

B-52 bases are:

- Minot Air Force Base, ND – 5th Bomb Wing
- Barksdale Air Force Base, LA – 2nd Bomb Wing (active Air Force) & 307th Bomb Wing (Air Force Reserve Command)
- One B-52H is assigned to the Air Force Flight Test Center at Edwards AFB.
- An additional B-52H is controlled by NASA as part of the Heavy-lift Airborne Launch program.

On 24 March 1999, when Operation Allied Force began, B-52 bombers bombarded Serb targets throughout the Federal Republic of Yugoslavia, including during the Battle of Kosare.

The B-52 again entered the tactical realm, supporting Operation Enduring Freedom in 2001 (Afghanistan/Southwest Asia), providing the ability to loiter high above the battlefield and provide Close Air Support (CAS) through the use of precision guided munitions, a mission which previously would have been restricted to fighter and ground attack aircraft. During the initial stages of Enduring Freedom, in late 2001, ten B-52s dropped a third of the bomb tonnage in Afghanistan. B-52s also played a role in Operation Iraqi Freedom, which commenced on 20 March 2003 (Iraq/Southwest Asia). On the night of 21 March 2003, B-52Hs launched at least one hundred AGM-86C CALCMs at targets within Iraq.

On 26 October 2012, Boeing marked 50 years since it had delivered its last B-52 Stratofortress to the U.S. Air Force. H-model bomber 61-040 had been assigned to Minot Air Force Base, N.D., where it remained in active service. Modern engineering analyses showed the B-52's expected lifespan extending beyond 2040.

As of January 2013, 78 of the original 744 B-52 aircraft were operational in the U.S. Air Force. Four of 18 B-52Hs from Barksdale AFB being retired are in the "boneyard" of 309th AMARG at Davis-Monthan AFB as of 8 September 2008.

In May 2014, The Air Force introduced the first B-52 aircraft upgraded with an advanced communications system developed by Boeing into its fleet. The Combat Network Communications Technology (CONNECT) modification added several communication data links, full-color LCD displays with real-time intelligence feeds overlaid on moving maps, a state-of-the-art computing network, and the ability to retarget a weapon, or mission parameters, in flight. At that time, the Air Force operated 76 B-52s primarily out of Barksdale Air

Force Base, La.; Minot Air Force Base, N.D., and Andersen Air Force Base, Guam, and planned to upgrade all of them. In late 2015, The US Air Force began removing nuclear weapons capability from 42 B-52H Stratofortresses, in line with regulations set out under the New Strategic Arms Reduction Treaty (New START), signed in April 2010. Thirty operational and a dozen mothballed Stratofortresses will be converted to solely conventional bombers, with work having already begun to this effect and due for completion by 2017. Both Russia and the US have until February 2018 to comply with the treaty's terms. Despite the conversion, planned work to upgrade the fleet of B-52H bombers will form part of a modernization effort to keep nuclear-capable B-2 and B-52s flying into the 2030s and 2040s respectively.

As of September 2015, 30 of the U.S. Air Force's fleet of more than 70 B-52 bombers had been converted to conventional-bombing capability only. The work to eliminate the aircraft's capability to deliver nuclear weapons was conducted at Barksdale Air Force Base in Louisiana to meet U.S. requirements under the New Strategic Arms Reduction Treaty with Russia -- known as the New START accord -- which came into effect in 2011.

The Air Force Global Strike Command said it will also convert 12 non-operational B-52H aircraft -- kept in storage by the service's 309th Aerospace Maintenance and Regeneration Group in Tucson, Ariz. -- to the conventional weapons-only variant. All conversions were expected to be completed by early 2017. Under the New START accord, the United States and Russia are required to have no more than 1,550 deployed warheads; 800 deployed and non-deployed intercontinental ballistic missile launchers, submarine-launched ballistic missile launchers and nuclear-capable heavy bombers; and 700 deployed ICBMs, SLBMs and nuclear-capable heavy bombers.



The McDonnell ADM-20 Quail was a subsonic, jet powered, air-launched decoy cruise missile built by McDonnell Aircraft Corporation. The Quail was designed to be launched by the B-52. Its original United States Air Force designation was GAM-72 (GAM standing for Guided Aircraft Missile) A total of 585 GAM-72A missiles were produced by McDonnell. The inventory of GAM-72As in the USAF peaked at 492 in 1963. (author)



The Spirit of 69. (Ken Buchanan)



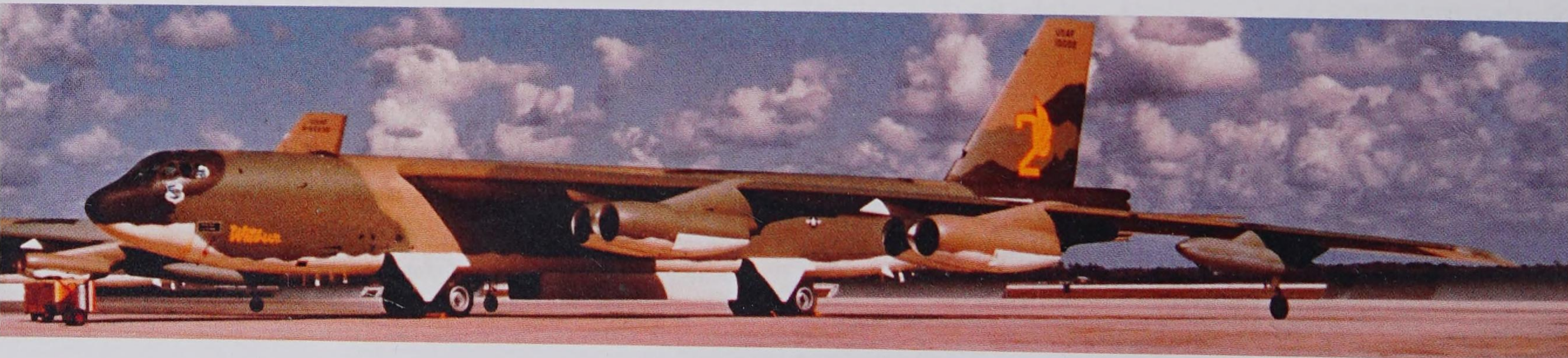
*B-52H-150-BW of the 92nd Bomb Wing at Van Nuys, CA
on 17 July 1992. (Ted Carlson/Fotodynamics)*

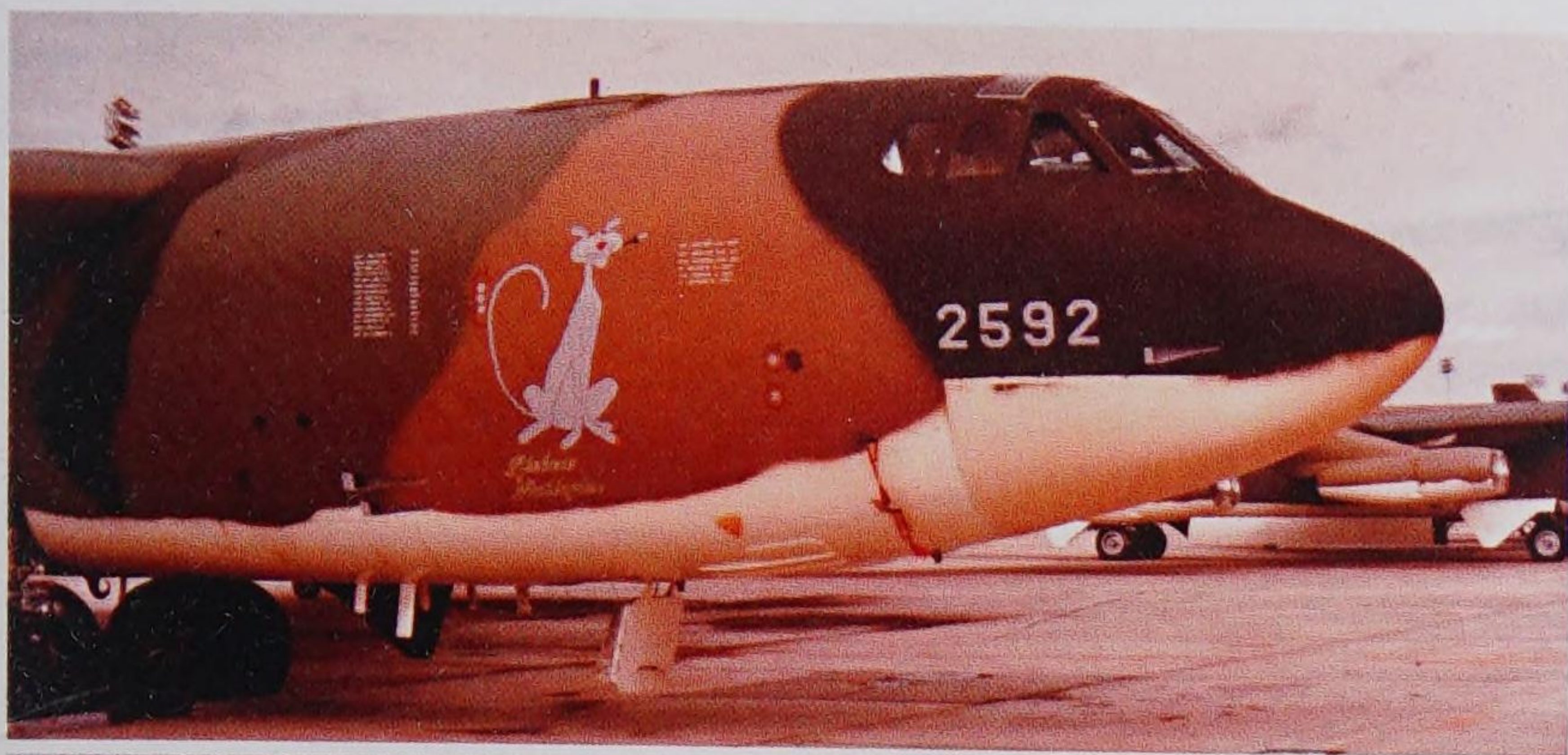


B-52G-110-BW 58-0235 of the 412th Test Wing, 419th Test Squadron at Edwards AFB 23 October 1993. (Ted Carlson/Fotodynamics)

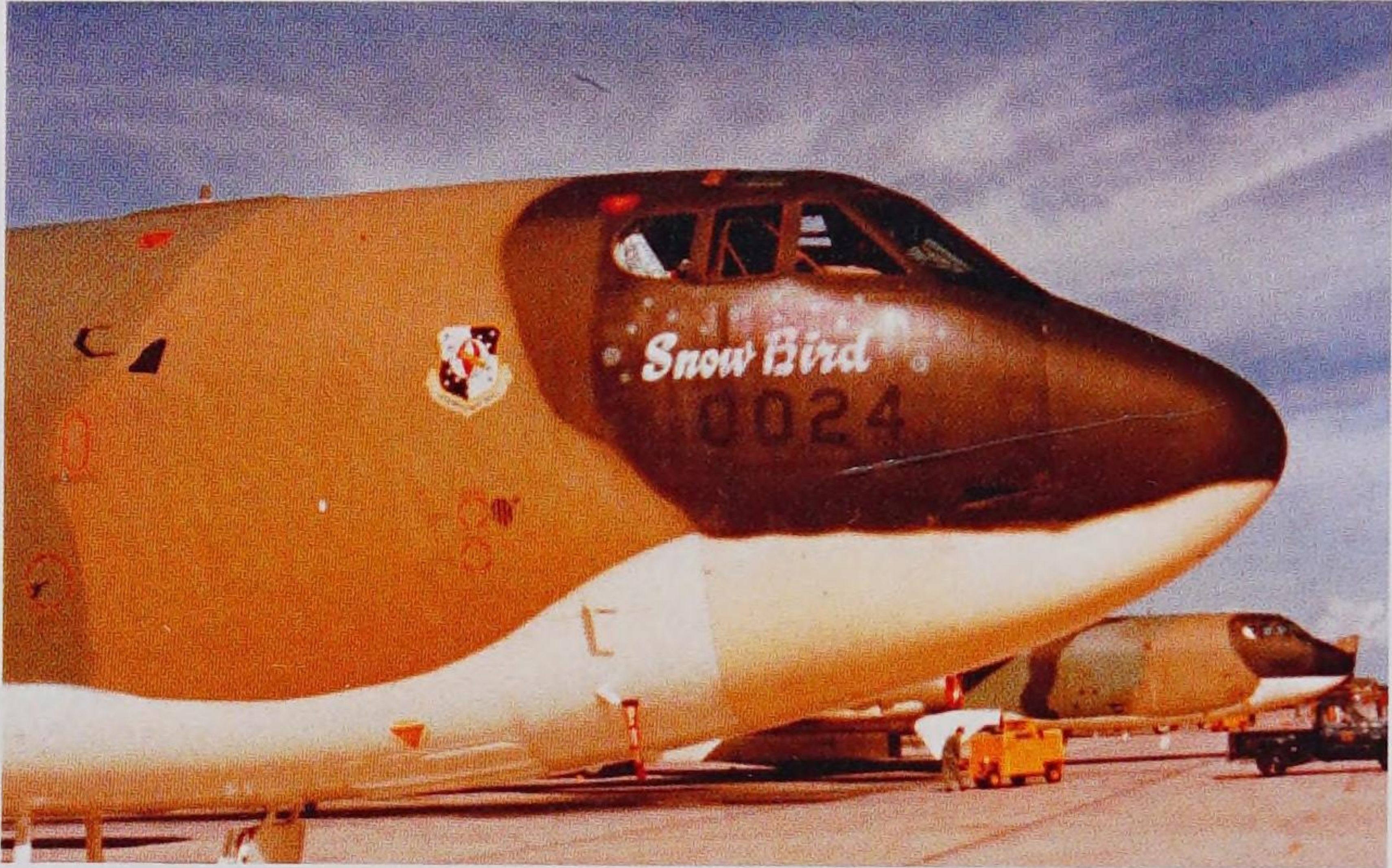
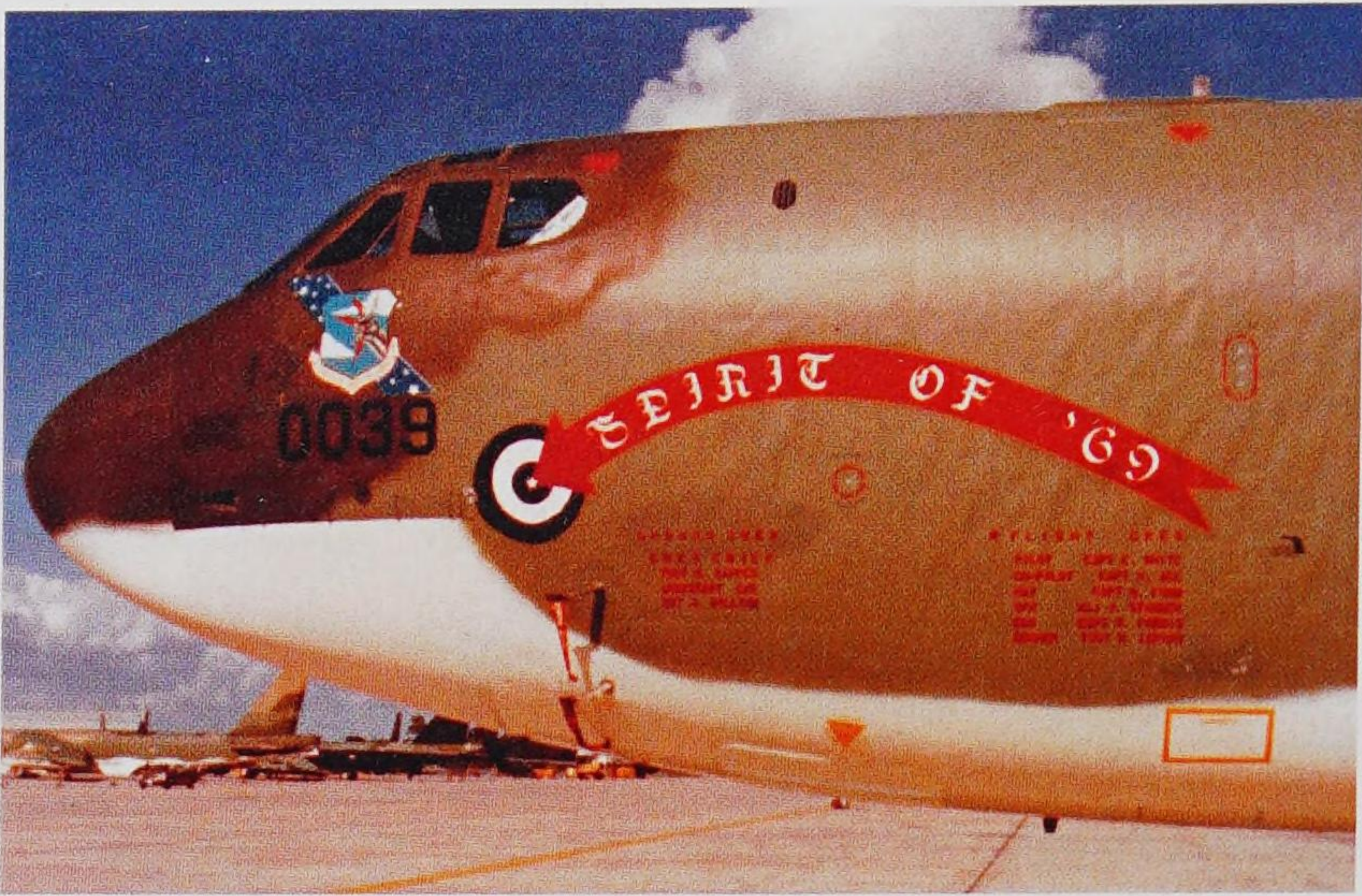


"Wilbur" with the winged 2nd Air Division insignia displayed during SAC Bomb Competitions. "Wilbur" was a B-52H-165-BW, serial 61-0002. (Ken Buchanan)





Continuing a tradition that dated to WWII, SAC allowed untis to name their bombers, especially during bomb competitions. This was meant to improve morale and foster pride in the crews. Unlike the WWII tradition, what SAC did not allow was the use of the pin-up art that was so prevalent in the combat zones of WWII. The use of pin-ups returned in a more subdued fashion during Desert Storm and the following war on terror, but the more lurid or artistic nose art was more often comic book or video game themed.



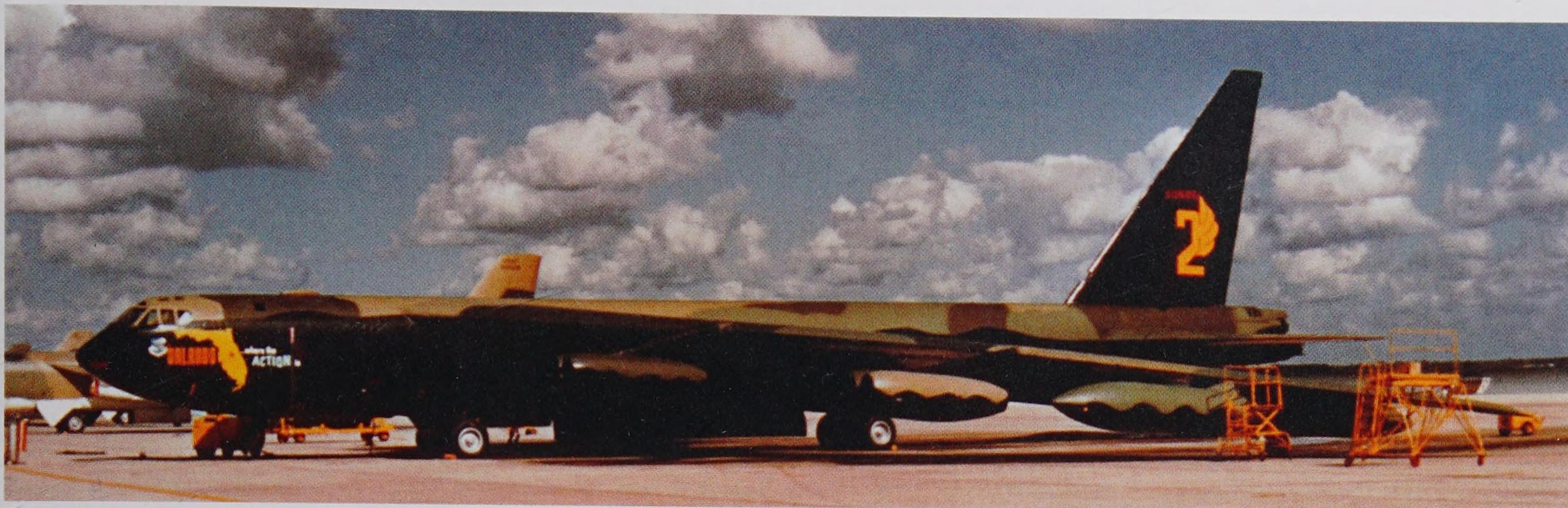


(above) B-52H Stratofortress aircraft (Serial Number - 60-0019) assigned to 2nd Bomb Wing (2nd BW) at Barksdale Air Force Base, Louisiana. USAF)

(below) B-52H Stratofortress aircraft (Serial Number - 60-0005) assigned to 23rd Expeditionary Bomber Squadron (23rd EBS) deployed from Minot AFB, North Dakota. (USAF)







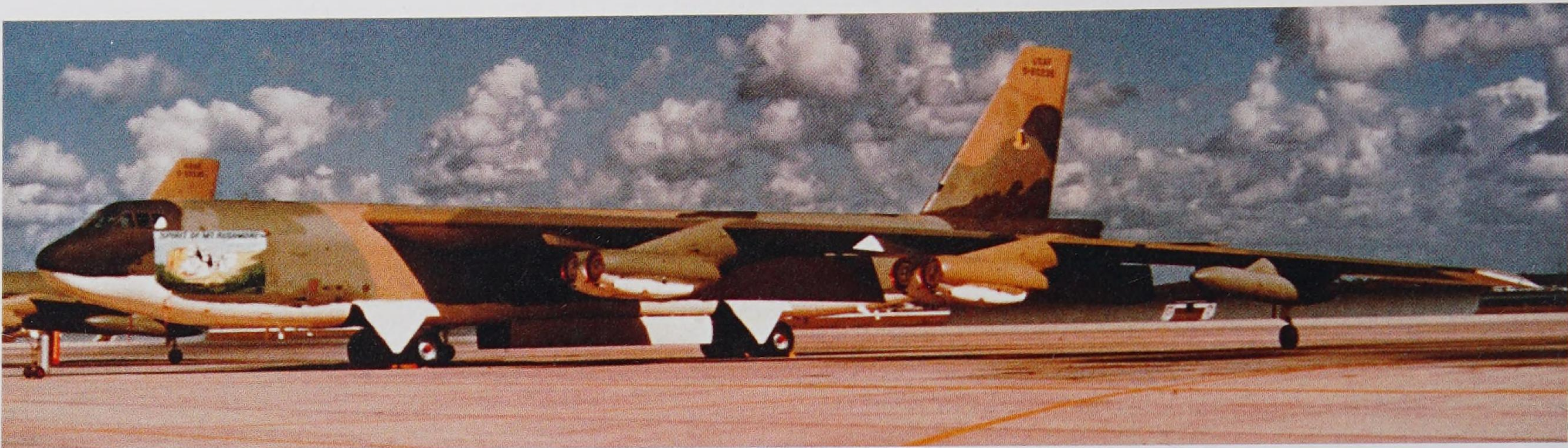
The “Action” was in Orlando when the current Orlando International Airport was McCoy AFB, a base for this 2nd Bomb Wing B-52D. (Ken Buchanan)



(Left) A B-52 Stratofortress arrives at Fairford Royal Air Force Base, U.K., Sept. 14, 2017. The deployment of strategic bombers to the U.K. helps exercise RAF Fairford and U.S. Air forces in Europe’s forward operating location for bombers. (U.S. Air Force photo/Staff Sgt. Benjamin Raughton)

Lt. Col. Jeremy Holmes, 69th Bomb Squadron CO, in the left seat of the B-52H Stratofortress Ghost Rider at Minot Air Force Base, N.D., Sept. 27, 2016. In 2008, Ghost Rider was sent to the 309th Aerospace Maintenance and Regeneration Group, aka Boneyard, at Davis-Monthan AFB, Ariz., and has spent the last year at both Barksdale AFB, La. and Tinker AFB, Okla., undergoing equipment transfers of usable equipment and undergoing inspections and corrective maintenance actions to ensure its airworthiness. (U.S. Air Force photo/Airman 1st Class J.T. Armstrong)





"Spirit of Mt. Rushmore" was a B-52G-110-BW of the 28th Bomb Wing, Ellsworth AFB, SD. Seen here in markings applied for the 1971 SAC Bomb Competition. The 28th converted from B-52G to B-52H models in 1977. They expanded the B-52H mission in 1984 to include sea reconnaissance, surveillance, and conventional operations from forward bases overseas. The wing was converted to the B-1B in 1986. (Ken Buchanan)



Airmen from the 20th Aircraft Maintenance Unit prepare to launch a B-52H Stratofortress, Jan. 31, 2013 at Nellis Air Force Base, Nev. The Barksdale Air Force Base, La., team was at Nellis to participate in Red Flag, a two-week, multinational advanced aerial combat training exercise. (U.S. Air Force photo/Senior Airman Matthew B. Fredericks)



Maxwell Matlock, 10, waves from the cockpit of a B-52H Stratofortress on Barksdale Air Force Base, La., Dec. 18, 2014. Matlock was honored by having his name on a B-52 as part of a presentation for becoming an Honorary Crew Chief. (U.S. Air Force photo/Senior Airman Joseph A. Pagán Jr.)

Good Bye SAC, Hello GSC

Strategic Air Command (SAC) was a United States Air Force (USAF) Major Command (MAJCOM) responsible for Cold War command and control of two of the three components of the U.S. military's strategic nuclear strike forces, the so-called "Nuclear Triad," with SAC having control of land-based strategic bomber aircraft and intercontinental ballistic missiles (ICBMs). SAC also operated all strategic reconnaissance aircraft, all strategic airborne command post aircraft, and all USAF aerial refueling aircraft, to include those in the Air Force Reserve (AFRES) and Air National Guard (ANG), with the exception of those KB-50, KC-97, HC-130 and MC-130 aircraft operated by Tactical Air Command (TAC), Military Airlift Command (MAC), Air Force Special Operations Command (AFSOC) from May 1990 onward, or associated AFRES and ANG aerial refueling aircraft gained by TAC, MAC or AFSOC. SAC primarily consisted of the Second Air Force (2AF), Eighth Air Force (8AF) and the Fifteenth Air Force (15AF), while SAC headquarters (HQ SAC) included Directorates for Operations & Plans, Intelligence, Command & Control, Maintenance, Training, Communications, and Personnel. At a lower echelon, head-

quarters divisions included Aircraft Engineering, Missile Concept, and Strategic Communications. In 1992, as part of an overall post-Cold War reorganization of the U.S. Air Force, SAC was disestablished as both a Specified Command and as a MAJCOM, and its personnel and equipment redistributed among the Air Combat Command (ACC), Air Mobility Command (AMC), Pacific Air Forces (PACAF), United States Air Forces in Europe (USAFE), and Air Education and Training Command (AETC), while SAC's central headquarters complex at Offutt AFB, Nebraska was concurrently transferred to the newly created United States Strategic Command (USSTRATCOM), which was established as a joint Unified Combatant Command to replace SAC's Specified Command role. In 2009, SAC's USAF MAJCOM role was re-activated and re-designated as Air Force Global Strike Command. Air Force Global Strike Command, activated Aug. 7, 2009, is a major command with its headquarters at Barksdale Air Force Base, Louisiana. AFGSC is responsible for the nation's three intercontinental ballistic missile wings, the Air Force's entire bomber force, to include B-52, B-1 and B-2 wings, the Long Range Strike Bomber program, and operational and maintenance support to organizations within the nuclear enterprise.

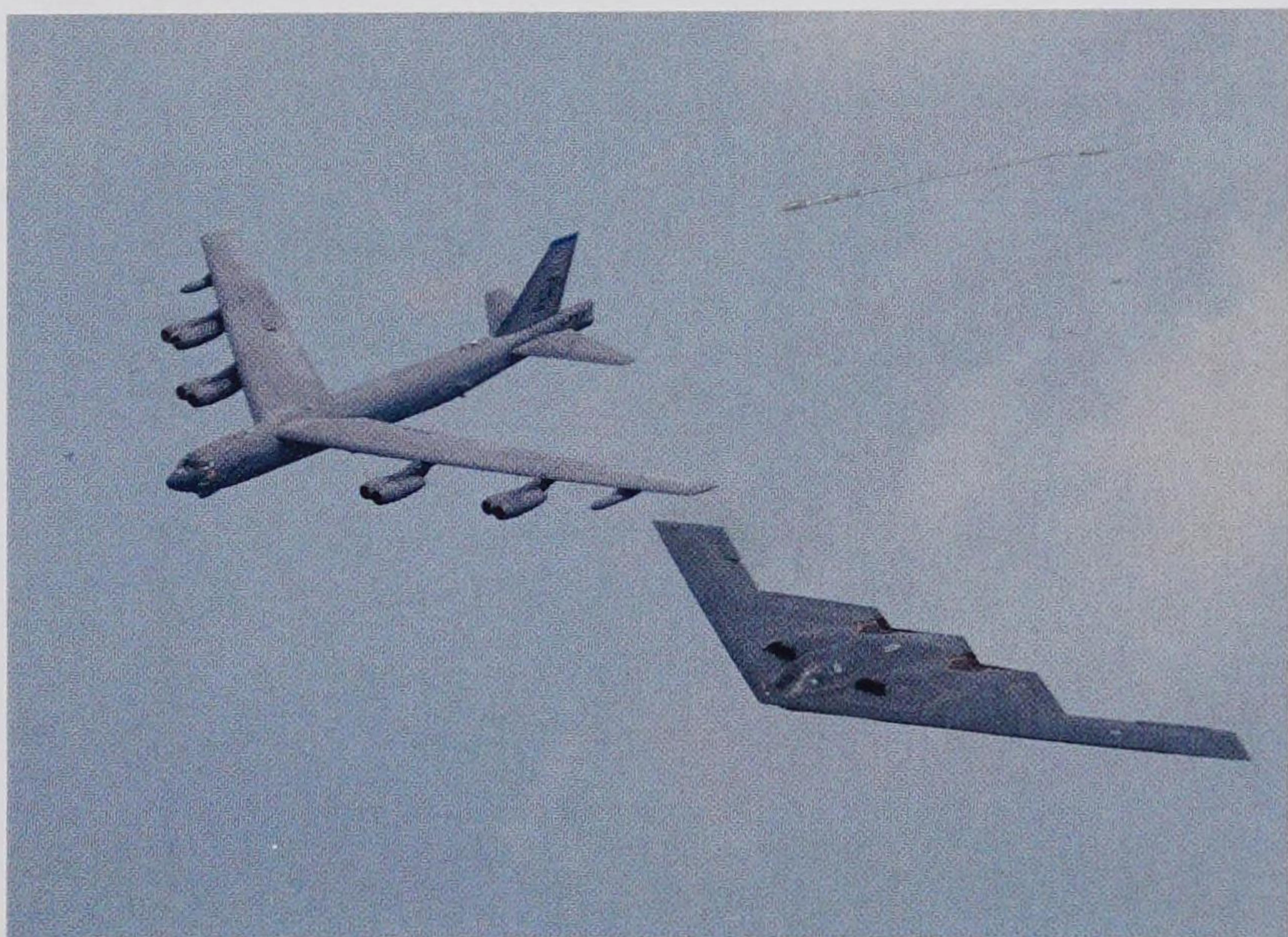


The mailed fist of SAC held the nuclear triad lightning bolts that safeguarded the nation during the cold war. When SAC was disbanded, the B-52 joined a unified Air Combat Command that contained all combat aircraft. Global Strike Command resurrected the WWII era Air Force logo and incorporated the triad lightning bolts.





The USAF Global Strike Command bomber force includes the bombers meant to replace the BUFF, the B-1 (above) and the B-2 (below), neither of which could replace the B-52's capacity for bomb load and range. This triad will remain in place for several years to come. (USAF)



A B-52 of the 69th Expeditionary Bomb Squadron from Minot Air Force Base, N.D., releases M117 air-dropped general purpose conventional bombs on a training range north of Andersen. The mission also included in-flight refueling, tactical maneuvers, and radar scenarios to test all aspects of the B-52s' capabilities. (U.S. Air Force photo/ Senior Airman Carlin Leslie)



BARKSDALE AIR FORCE BASE, La. (AFPN) -- Munitions on display show the full capabilities of the B-52 Stratofortress. The wide variety of munitions range from conventional bombs to precision guided bombs and air-launched cruise missiles. (U.S. Air Force photo by Tech. Sgt. Robert J. Horstman)



B-52H -135-BW of the 19th Bomb Wing, 8th Air Force, as it appeared during the RAF Strike Command bomb competition at RAF Markham, UK in March, 1967. The inscription on the fuselage reads: "Dear Rocky, not to win is a very bad thing." Despite this warning, none of the three SAC representative crews managed to bring home a trophy. This was a big change from the previous years' competition, when on 2-8 October 1966, the Fifteenth Annual Bombing Competition was held again at Fairchild AFB with one crew and aircraft from 35 B-52 wings and two B-58 wings. Aerial tankers again did not compete. The RAF was represented by three crews flying the Vulcan bomber. Each completing crew flew two missions consisting of on-time takeoff, night celestial navigation, two low altitude bombing runs (four releases) and one high altitude bombing run (two releases). General David Wade, Commander of Eighth Air Force coined the motto, "Not to Win is a Very Bad Thing" – and with this encouragement 8 AF dominated the Bomb Comp capturing the first four places in the overall competition with its 19 BW (B-52) (8 AF) taking the Fairchild Trophy. The 19th was moved without personnel or equipment to Robins Air Force Base, Georgia in mid-1968, it absorbed resources of the 465th Bombardment Wing and converted to the B-52G. At Robins, the 19th furnished B-52 Arc Light crews and KC-135 aircraft and crews supporting Yankee Team, Foreign Legion & Young Tiger Tanker Task Force and crews to other SAC organizations. In the Spring & summer of 1972, all assigned B-52G's aircraft & crews deployed to the Strategic Wing (Provisional) at Andersen Air Force Base. In 1972, the wing deployed virtually all its aircraft and crews for combat operations. In November 1973, the wing returned from deployment and resumed normal operations. The 19th Bombardment Wing won the Omaha Trophy as the "Outstanding Wing in SAC" for 1981. Proving the old adage that "no good deed goes unpunished", the 19th was stripped of its bombers in 1983, and became a refueling wing with KC-135s. (Painting by the author)



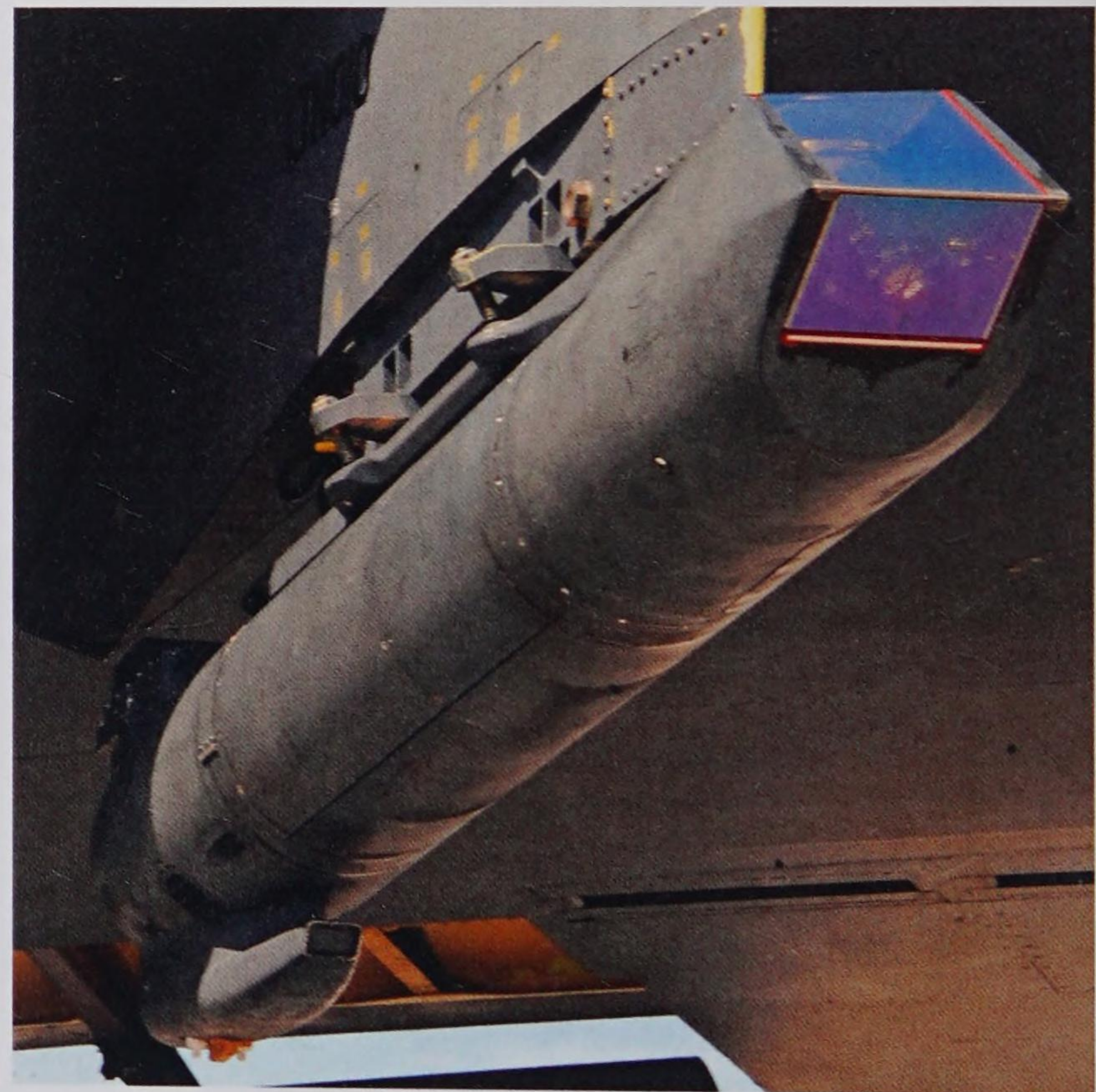
Airmen from the 36th Expeditionary Aircraft Maintenance Squadron prepare a B-52 Stratofortress for launch July 2, 2013, on the Andersen Air Force Base, Guam, flightline. Members of the 36th EAMXS are deployed here from Minot Air Force Base, N.D., to provide maintenance support to 23rd Expeditionary Bomb Squadron. (U.S. Air Force photo by Airman 1st Class Marianique Santos)



Capt. Patrick Applegate, 23rd Expeditionary Bomb Squadron removes ground safety pins Jan. 29 on a MAU-12, prior to a B-52 Stratofortress live drop mission for exercise Tropic Fury over the Farallon de Medinilla Target Range. The B-52 dropped live M-117 ordnance during the exercise. Tropic Fury was developed to train aircrew on the use of conventional air launched crew missiles (CALCM) and joint air to surface standoff missile (JASSM) conventional weapon systems. The B-52 was deployed from Minot, N.D., to Andersen A.F.B. Guam, 23rd Expeditionary Bomb Squadron. Training missions such as this one ensures the maintenance and aircrew both perform real world tactics and defensive measures by loading and dropping live weapons on target. The bomber's participation in constant training helps emphasize the U.S. bomber presence, demonstrating U.S. commitment to the Pacific region. (U.S. Air Force photo by: Master Sgt. Kevin J. Gruenwald)



(below) Maj. Brett Plummer, 20th Bomb Squadron radar navigator, inspects the LITENING Advanced Targeting pod on the wing of a B-52H Stratofortress on Barksdale AFB. ATPs are used on a wide variety of aircraft including the B-52H, A-10 and F-16. The ATP is a self-contained, multi-sensor weapon aiming system that enables the aircrew to detect, acquire, auto-track and identify targets for highly accurate delivery of both conventional and precision-guided weapons. (USAF photo/Airman 1st Class Benjamin Gonsier)



Lockheed Martin's [NYSE:LMT] Sniper® Advanced Targeting Pod (ATP) achieved operational flight status on the B-52 bomber on 25 July 2013. The Sniper ATP provides pilots high-resolution imagery for precision targeting and non-traditional intelligence, surveillance and reconnaissance missions. Sniper ATP detects, identifies, automatically tracks and laser designates small tactical targets at long ranges. It also supports employment of all laser- and GPS-guided weapons against multiple fixed and moving targets. A video datalink enables pilots to share real-time video with troops on the ground for improved situational awareness and rapid target coordination. (USAF)





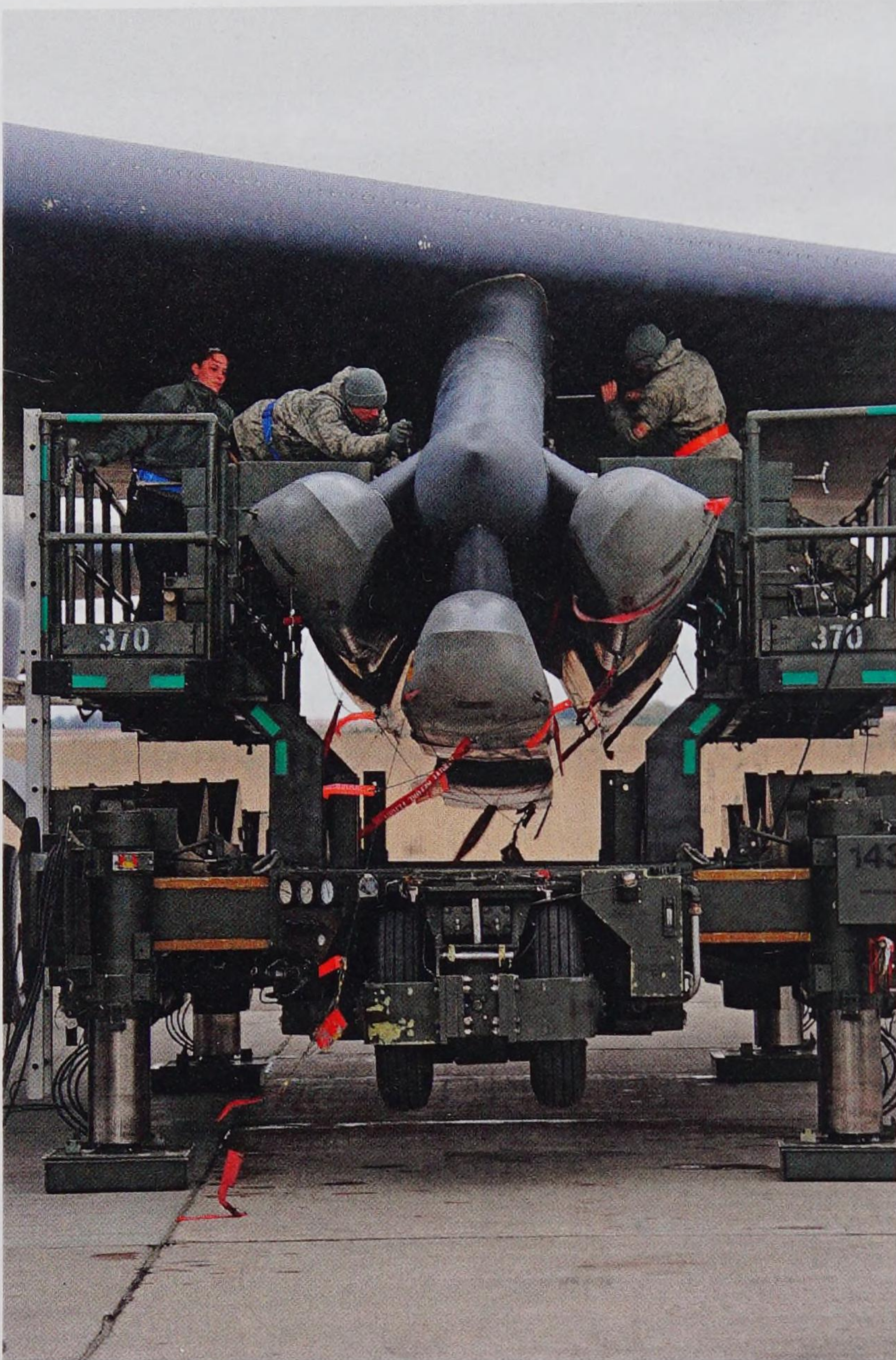
U.S. Air Force Capt. Zachary Proano, 23rd Bomb Squadron radar navigator, conducts a pre-flight inspection of a targeting pod on a B-52H Stratofortress at Minot Air Force Base, N.D. on 11 February 2014. The B-52 is capable of flying at high subsonic speeds at altitudes up to 50,000 feet. It can carry a variety of weapons including nuclear and precision guided conventional ordnance with worldwide precision navigation capability. (U.S. Air Force photo by Staff Sgt. Jonathan Snyder)



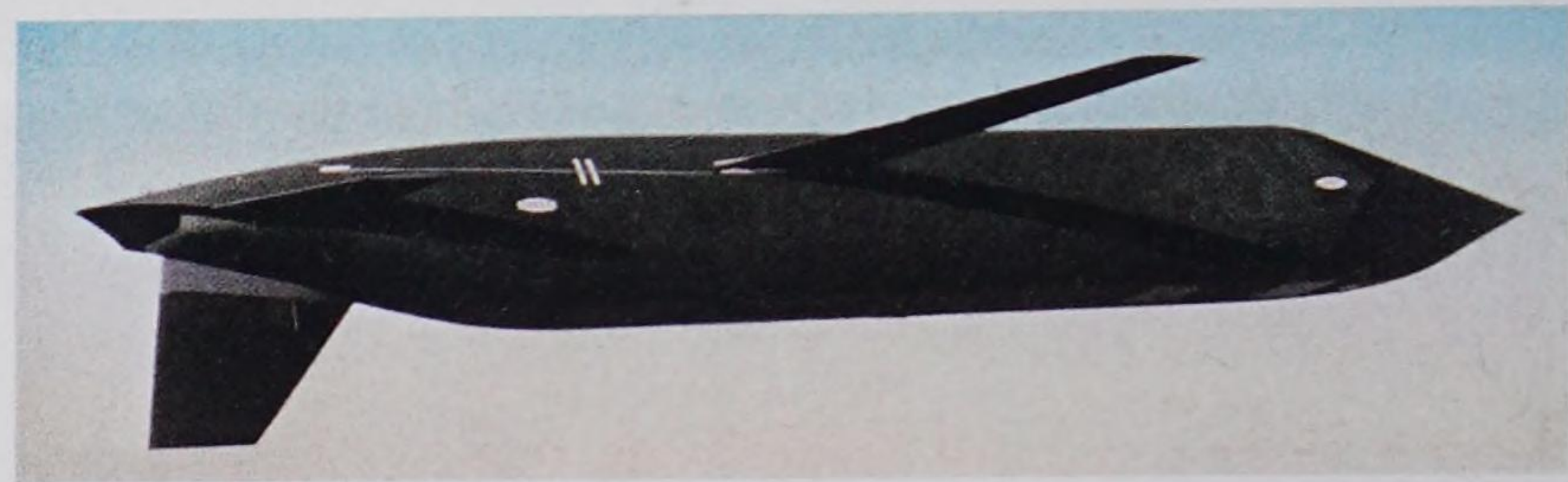
SOUTHWEST ASIA (AFPN) -- A B-52 Stratofortress, flown by Capt. Will Byers and Maj. Tom Aranda, prepares for re-fueling over Afghanistan during a close air-support mission. The KC-135 Stratotanker transfers fuel at about 16 gallons per second. The crew is deployed from the 2nd Bomb Wing, Barksdale AFB. The JDAMS loaded on external pylons give the B-52 the requisite accuracy for close air support missions. (U.S. Air Force photo by Master Sgt. Lance Cheung)



Weapons loaders assigned to the 307th Aircraft Maintenance Squadron finish installing a simulated AN/ASQ-236 Radar Pod on a 93rd Bomb Squadron B-52H Stratofortress, April 7, 2014, Barksdale Air Force Base, La. The pod is the actual shape, length and weight of the AN/ASQ-236, and the installation was to test loading procedures on a B-52. (U.S. Air Force photo by Master Sgt. Greg Steele)



Weapons loaders assigned to Air Force Global Strike Command secure air-launched cruise missiles on a B-52H Stratofortress during a Constant Vigilance aircraft generation exercise at Minot Air Force Base, N.D., May 7, 2015. Exercises such as Constant Vigilance provide training opportunities to ensure AFGSC is ready to provide the President and combatant commanders with nuclear deterrence and long-range strike capabilities if and when called upon to do so. (U.S. Air Force photo/Senior Airman Kristoffer Kaubisch)



The AGM-129 ACM (Advanced Cruise Missile) was a low-observable, subsonic, turbofan-powered, air-launched cruise missile originally designed and built by General Dynamics and eventually acquired by Raytheon Missile Systems. Prior to its withdrawal from service in 2012, the AGM-129A was carried exclusively by the US Air Force's B-52H Stratofortress bombers. In March 2007, despite a Service Life Extension program (SLEP) intended to extend its operational usefulness to 2030, the USAF made the final decision to decommission its entire inventory of AGM-129s with the last missile being destroyed in April 2012.



OPERATION IRAQI FREEDOM -- Airman 1st Class Dino Dan, weapons loader, uses an MHU-83 lift truck to load a GBU-31 joint direct attack munition onto the wing of a B-52 Stratofortress. (U.S. Air Force photo by Staff Sgt. Kristina Barrett)



Ordnancemen use an MJ-1 bomb loader to load Mark 117 750-lb. bombs on a B-52 Stratofortress aircraft during Operation Desert Shield. (USAF by CMSGT Don Sutherland)



BARKSDALE AIR FORCE BASE, La. -- Capt. Peter Terrebonne inspects 2,000-pound Joint Direct Attack Munitions here before a training mission May 20. Captain Terrebonne is a B-52 Stratofortress radar navigator assigned to the 340th Weapons School. (U.S. Air Force photo by Airman Tabitha Wininger)



(above) Staff Sgt. Joshua Sweet (right) guides Airman 1st Class Wayne Robinson as he positions an Mk 56 mine under the wing of a B-52 Stratofortress. Staff Sgt. Jason Smith (on ladder) and Sergeant Sweet will secure the weapon once it is in position. The three are weapons loaders with the 36th Expeditionary Aircraft Maintenance Squadron at Andersen Air Force Base, Guam. (U.S. Air Force photo/Staff Sgt. Eric Petosky)

(left) Staff Sgt. Eric Hathaway, 5th Aircraft Maintenance Squadron weapons load crew team chief, and Senior Airman Chaz Geurrero, 5th AMXS weapons load crew member secure a MJ-1 bomb onto a B-52H Stratofortress on Minot Air Force Base, N.D., April 8, 2015. The AMXS weapons section is responsible for ensuring the reliability and safe handling of all explosive devices or countermeasures loaded on the B-52H Stratofortress. (U.S. Air Force photo/ Senior Airman Kristoffer Kaubisch)



Air Force munitions specialists from the 28th Air Expeditionary Wing download Joint Direct Attack Munitions from a B-52H Stratofortress at an operating location in support of Operation Enduring Freedom on Nov. 28. Coalition forces used about 110 strike aircraft against Taliban and al Qaeda forces Dec. 2. About 90 of those were tactical jet aircraft from sea-based platforms, about 12 to 14 were land-based tactical jets, and between eight and 10 were long-range bombers. (U.S. Air Force photo by Staff Sgt. Shane Cuomo)



(left) An Air Force munitions specialist from the 28th Air Expeditionary Wing changes the configuration of a B-52H Stratofortress external bomb rack from Joint Direct Attack Munitions to conventional munitions at an operating location in support of Operation Enduring Freedom. In the first 52 days of Operation Enduring Freedom, the Air Force flew more than 4,600 sorties, almost half of all OEF missions. (U.S. Air Force photo by Staff Sgt. Shane Cuomo)

(below) French Lt. Gen. Paul Fouillard and a delegation of French military officers watch Staff Sgt. Tabnee Bouvy demonstrate how her team operates a weapons loader for a B-52 Stratofortress during their visit to Air Force Global Strike Command. General Fouillard is the French Strategic Air Forces commander-in-chief and Sergeant Bouvy is a weapons load team member from the 2nd Bomb Wing at Barksdale Air Force Base, La. (U.S. Air Force photo/Master Sgt. Corey A. Clements)



B-52 Engines

The J57 engine powered the B-52A-G models. It was the world's first jet engine to develop 10,000 pounds thrust. It evolved from the T45 turboprop engine designed for the XB-52 program, but when the B-52 design changed from prop to jet, the turboprop concept was discarded and the wasp-waisted J57 turbojet was developed. The J57 featured a dual-rotor axial-flow compressor, which allowed low fuel consumption over a wide-operating range and improved the sluggish acceleration previously characteristic of jet engines.

The J-57 went into production in 1953. America's highest aviation honor, the Collier Trophy, was awarded for the design and development of the J-57 that year. Using a J57, the North American YF-100A became the world's first fighter aircraft to reach supersonic speed in level flight, on its maiden flight on May 25, 1953.

Later versions of the J57 and its commercial equivalent, the JT3, reached the 18,000 pounds thrust level with an afterburner. When production ended in 1970, more than 21,000 of these engines had been built. In addition to the B-52 and F-100, the J57 (or JT3) powered the Vought F8U; Douglas F4D, F5D and A3D; Boeing 707 and 720; Douglas DC-8; and numerous USAF aircraft including the KC-135, F-101A and F-102A.

As popular and leading edge as the J-57 was early in its career, its turbojet limitations became evident with the introduction of the fan jet engine, and the latest version of the B-52, the B-52H would be powered by a new fan jet. The Pratt & Whitney JT3D was developed from the J-57. It was one of the first turbofan aircraft engines, and was first run in 1958, then first flown in 1959 by a B-45 Tornado test aircraft. Over 8,000 JT3Ds were produced between 1959 and 1985. Most JT3D engines still in service today are used on military aircraft, where the engine is referred to by its USAF designation of TF33.

The B-52H is projected to remain in service for up to 2040, and the advances in engine design continue to dictate that the USAF look to the possibility of reengining the B-52 to take advantage of the performance of these new engines. The problem with this is the initial cost, and the defense budget has taken significant hits from cost overruns on leading edge programs. USAF would love to re-engine the B-52H, and they continue to explore possibilities.

According to Lt. Gen Mike Holmes, deputy chief of staff for Strategic Plans and Requirements;

"To go out and buy new engines for the B-52, you'd have a really hard time fitting that into our program, but that's why we're interested in a public-private partnership, which would be a different way to amortize those engines over time and pay for them in the savings that they actually generate, instead of paying for them out of savings that you hope for.... The idea is in a public-private partnership, somebody funds the engine and then we pay them

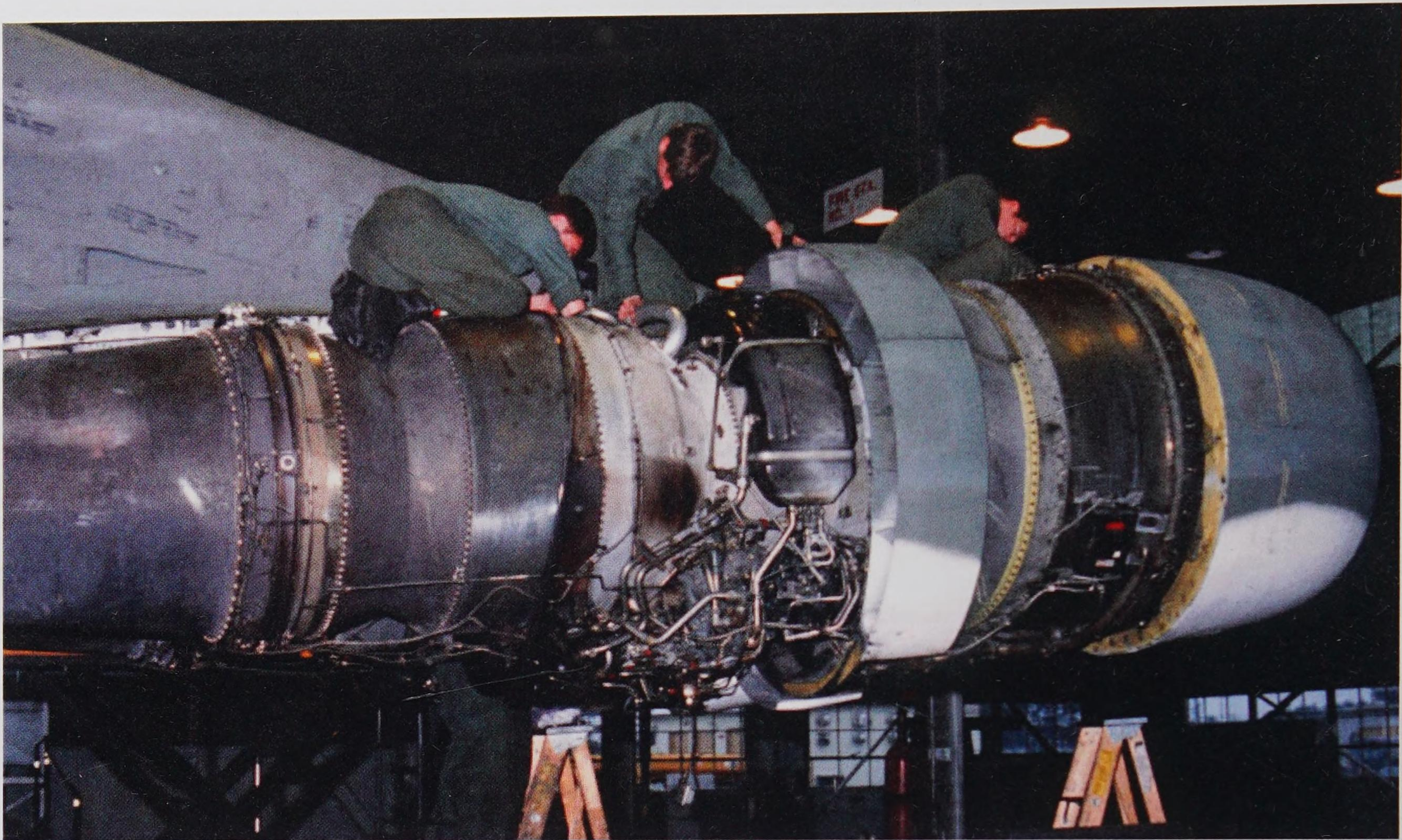
back over time out of the fuel savings, which are generated out of the new engines. Our government has a way to do that with facilities. We don't have a way to do that with airplanes, and we are exploring whether there are alternative ways that would let us do that... Look at what the airline industry is doing — they're all re-engining. Why? Because it saves you a lot of money. If there is a commercially available engine which can give a 25-30 percent increase in either range or loiter, you have my attention."

The B-52 has been around long enough, and the TF-33 is "old technology" enough that new engines have been considered as far back as the 1980s. There was a serious proposal almost 20 years ago, in which the B-52s would be re-engined with four General Electric CF6 high-bypass turbofans. The Air Force demurred, concluding that spending \$4 billion on new engines for the B-52 fleet would end up saving 'just' \$400 million, and that is only if the jets flew another 40 years, and who would have thought, in 2000, that the Buff would still be flying in 2040? (It was later pointed out that this study did not take into consideration the savings on tanker resources that would not be needed with new, longer-range and economical engines.)

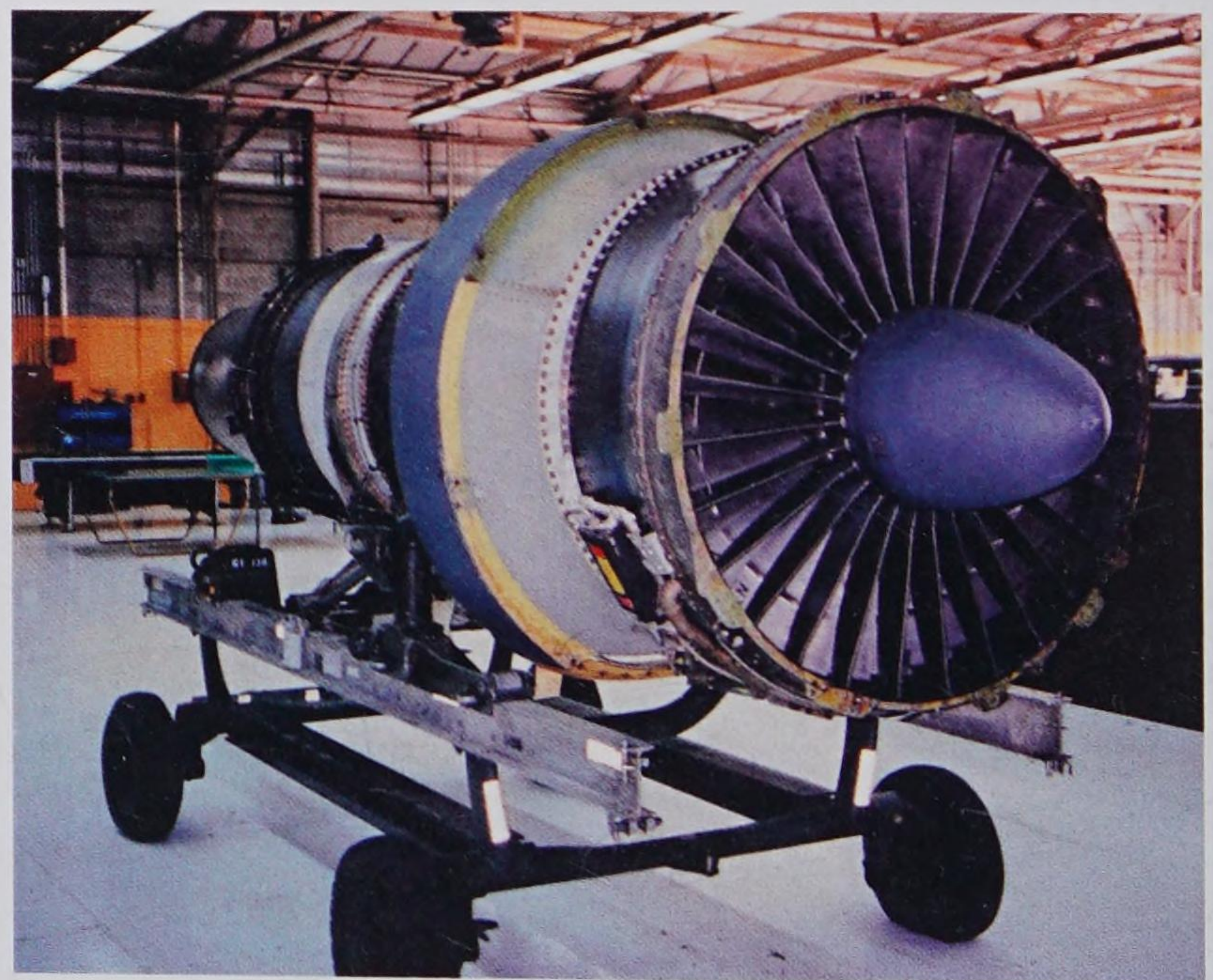
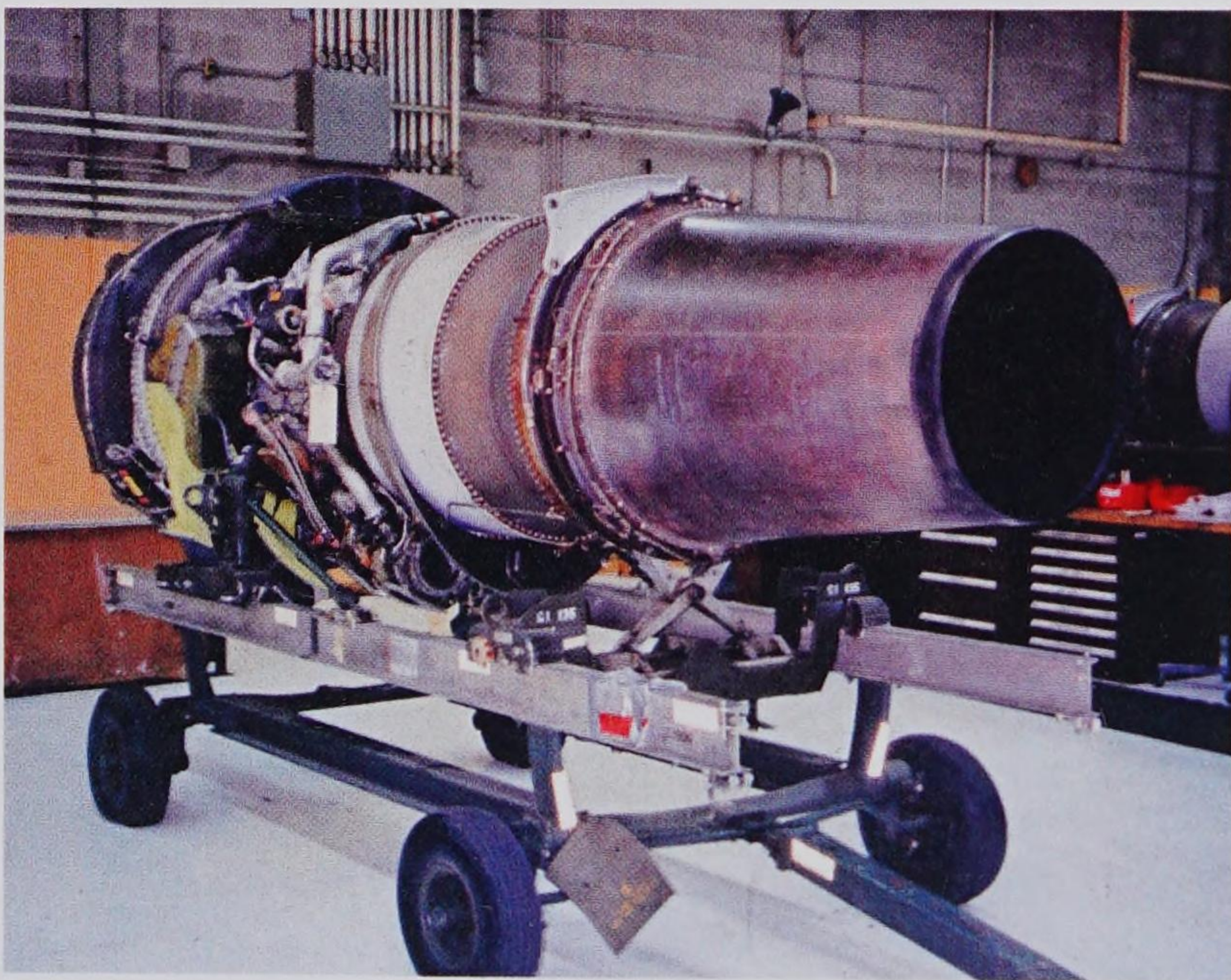
Another proposal for a B-52 re-engine is the Pratt & Whitney PW2000 (military designation F117). The F-117 powers the C-17 and the PW2000 is the Boeing 757 engine. USAF has the requisite experience to deal with the F-117 because of their C-17 support troops, so USAF might consider this approach. If the re-engine proposal gains any serious traction, the competition will no doubt step up to the plate. It is reasonable to assume that General Electric will compete with either their CF6 or CF34-10, and Rolls Royce would also likely bid on the project. If any of that happens, the B-52 may be around beyond 2040. Could there be a B-52 Centennial?



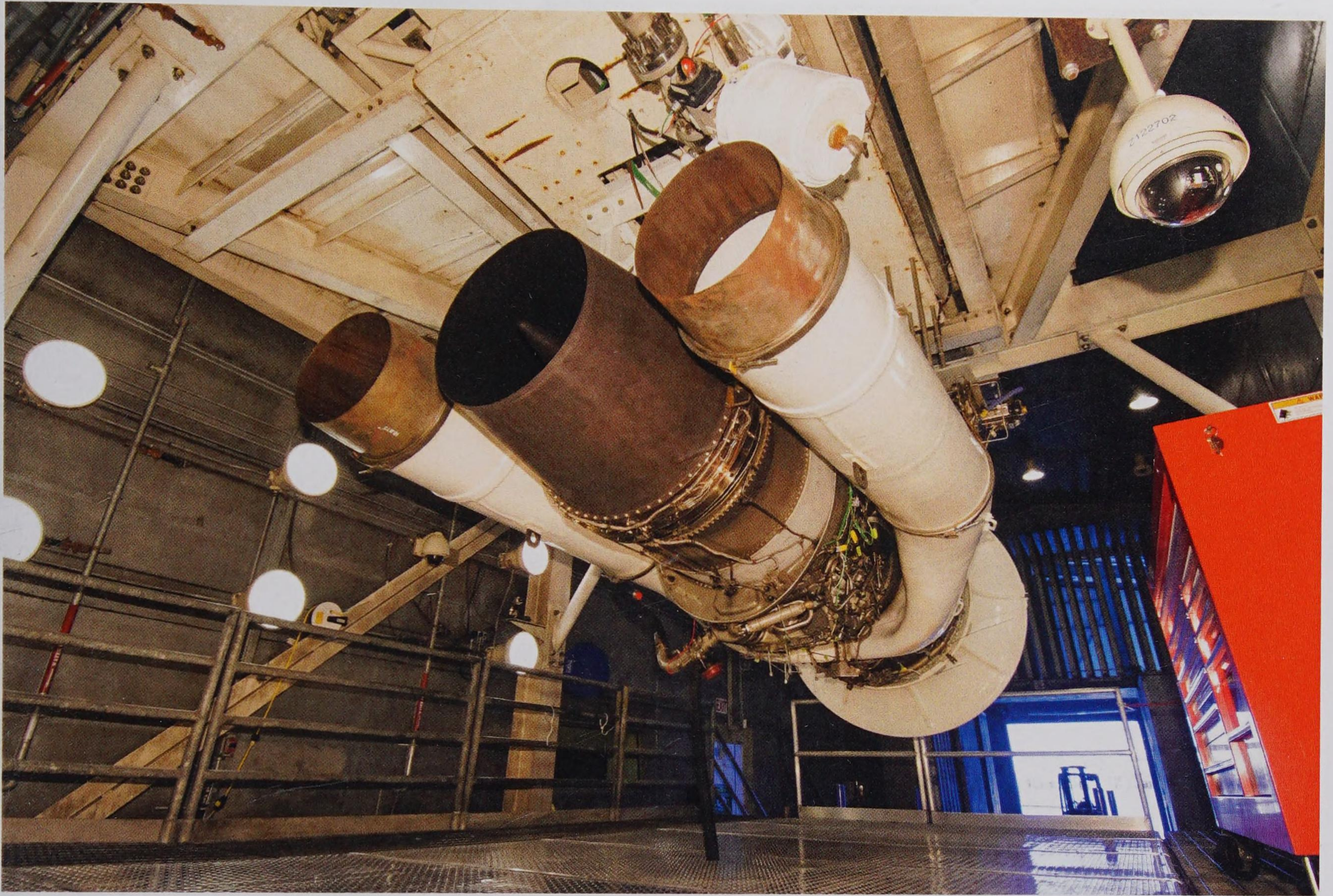
Installing overhauled J-57 engines on a B-52D in 1984.



Maintenance being performed on a J-57 engine. The J-57 powered B-52 models A through G. The zJ-57 engine was produced from 1951 to 1965 with a total of 21,170 built. On military B-52s and KC-135s, the J57 was available with water injection to increase the take-off rated thrust. Water injection could be used for the initial two minutes of take-off using demineralized water. The J57 was a very durable engine but, like most turbojet engines, it was very noisy. A heavy weight KC-135A using water injection was the loudest airplane in the USAF inventory and during a wet takeoff it generated up to 165 db.



The last new TF-33 engine was produced in 1985, but Pratt & Whitney continues to improve this seemingly timeless design. The T33 was the first turbofan engine designed and produced by P&W, and some drawings date back before 1959. The JT3 commercial variant first flew on the Boeing 707 on 22 June 1960 and the TF33 powered the B-52H's first flight one year later on 6 March, according to the company. The TF-33 was the follow-on fan jet version of the J-57. It celebrated its 55th anniversary in 2015.



Testing of the TF33 Pratt and Whitney engine is being conducted at Arnold Engineering Development Center to verify and validate newly redesigned components of the engine.

The TF33 has powered several different military airframes, including the Boeing KC-135 Stratotanker, E-3 Sentry (AWACS) and the E-8 Joint STARS.

Second Lt. Karlie Madden, the AEDC project manager for the test, stated that the engine currently being tested is a 17,000-pound thrust variant used aboard the B-52H Stratofortress airframe.

“The testing at AEDC is to verify and validate the structural integrity and durability of a redesigned inlet case and turbine exhaust case,” she said. “The test also includes accelerated mission testing which simulates approximately one-half of an overhaul cycle of testing on the engine, running approximately 690 sea-level operating hours. Multiple performance calibrations have been performed to determine if there are any new performance standards that stem from the redesigned components.”

The testing took place in one of the AEDC Engine Test Facility sea level test cells during the summer and wrapped up in November. The test was requested by the TF33 Systems Program Office of the Air Force Life Cycle Management Center Propulsion Directorate (AFLCMC/

LPS) at Tinker Air Force Base, Oklahoma.

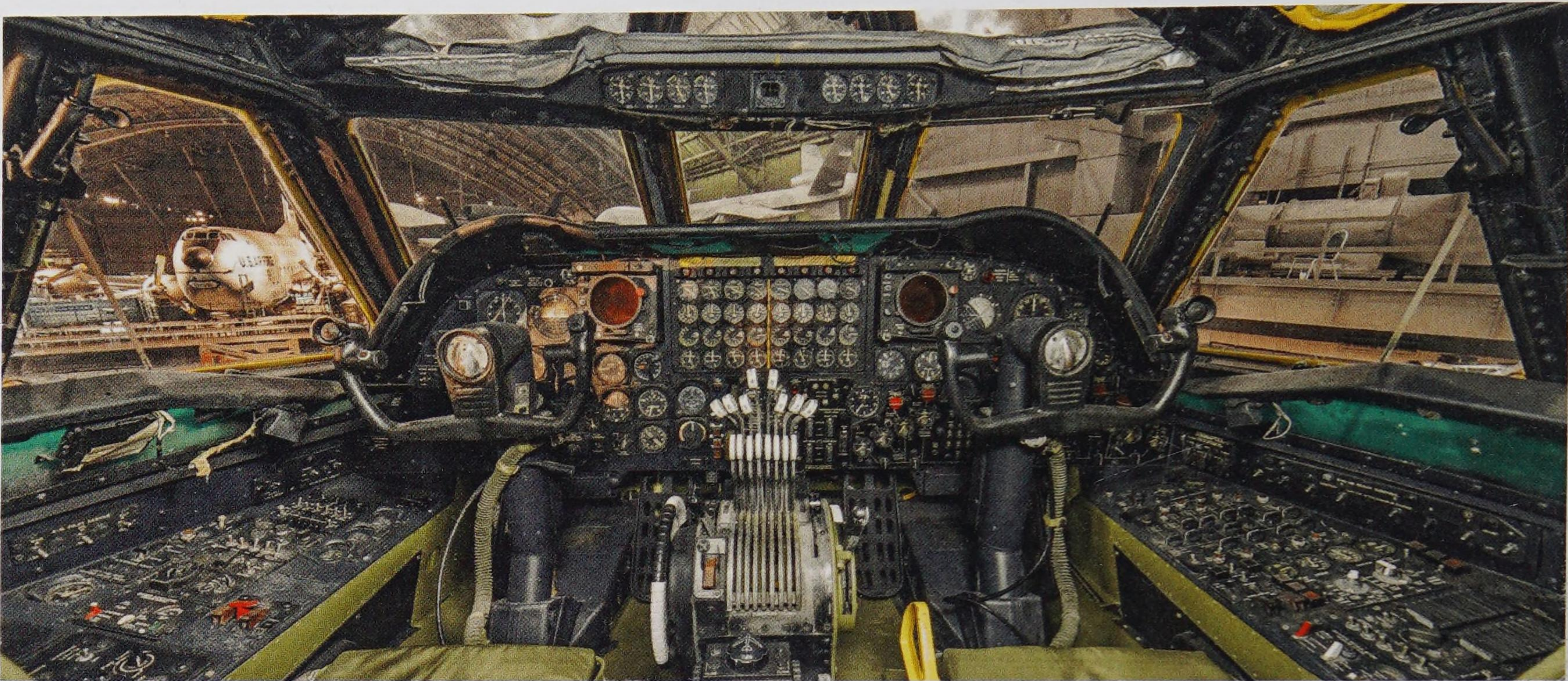
Though tested at AEDC before, it was the first installation of the TF33 in this sea level test cell.

The last TF33 test was conducted in the ETF C-2 test cell in 1995, during which AEDC characterized cold weather starting techniques between JP4 and JP8 jet fuel.

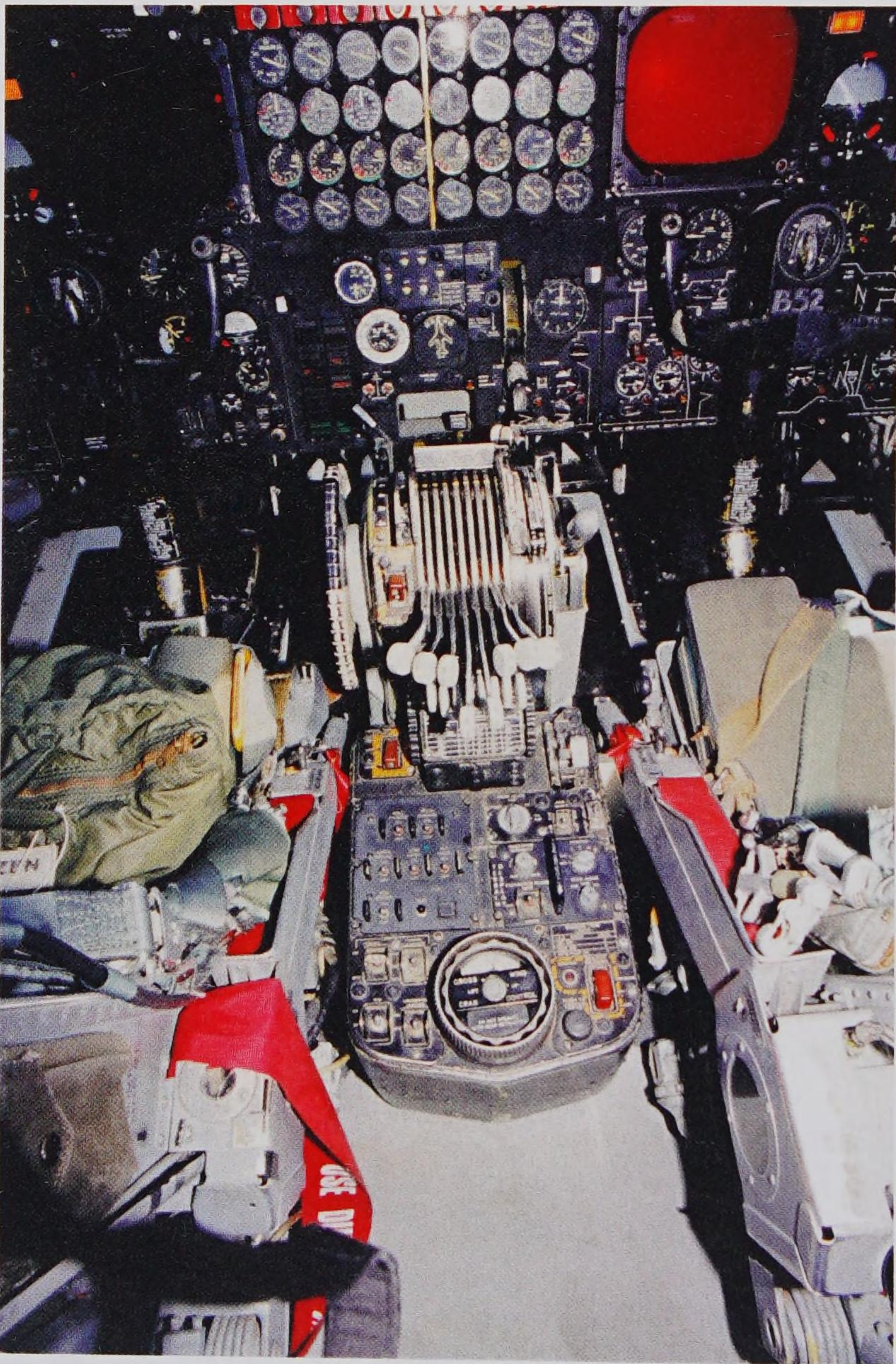
Of the most recent test, James Burt, a TF33 equipment specialist with the AFLCMC/LPS, commented that working with AEDC on the TF33 accelerated mission testing proved to be an “outstanding experience.”

“We have had no engine issues and all test cell issues were worked and resolved very quickly with little to no test down time,” he said. “This has resulted in the smoothest TF33 AMT test to date and allowed the test to complete ahead of schedule.”

Testing was also completed early and 55 successful air periods were performed in 61 days, making the project successful both technically and financially.



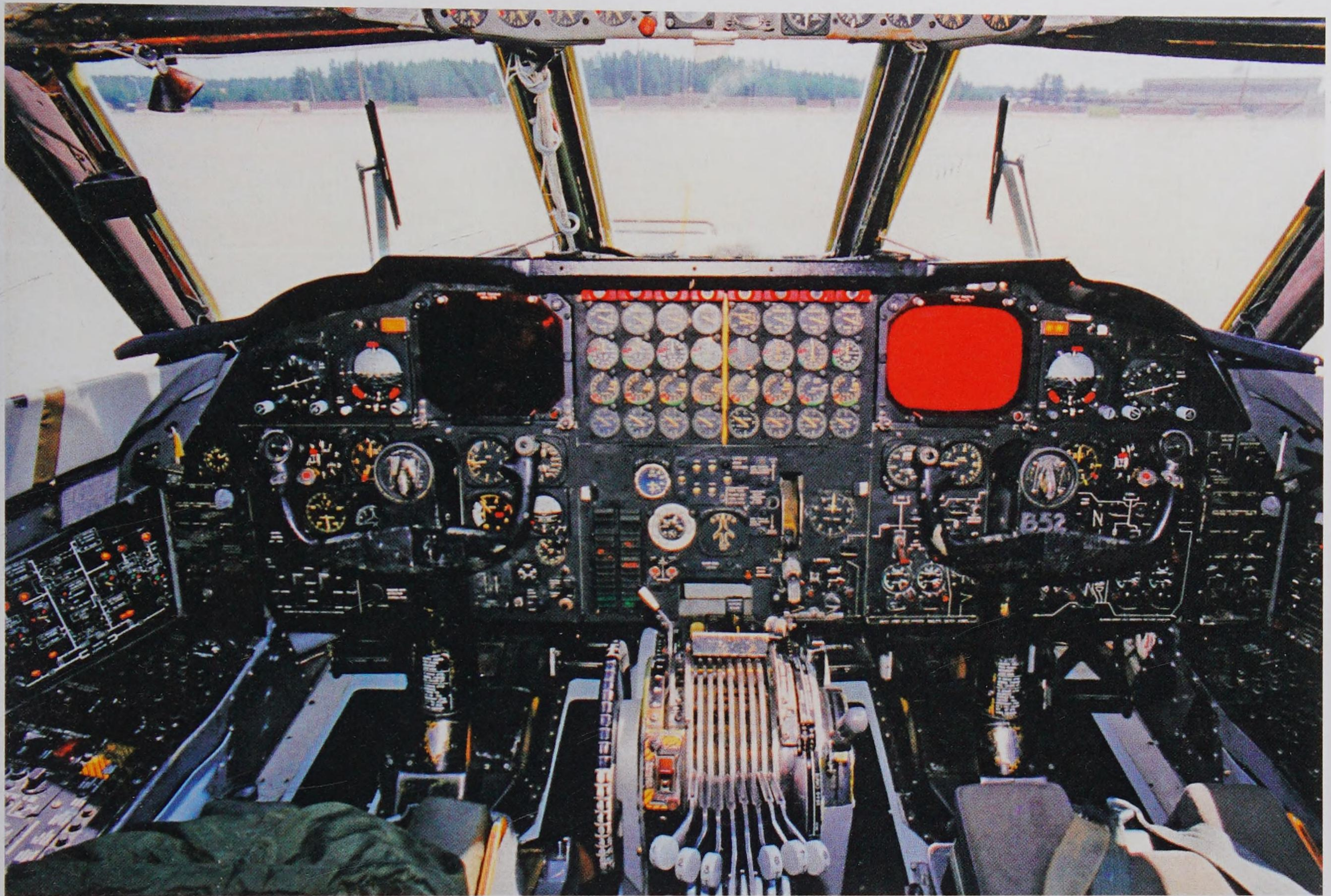
The original, 1950s era cockpit of the B-52D on display at the National Museum of The USAF.



*The center console of a B-52G is dominated by the thrust levers, but also contains trim wheel, landing gear and flap levers and landing gear cross wind adjustment wheel.
(author)*

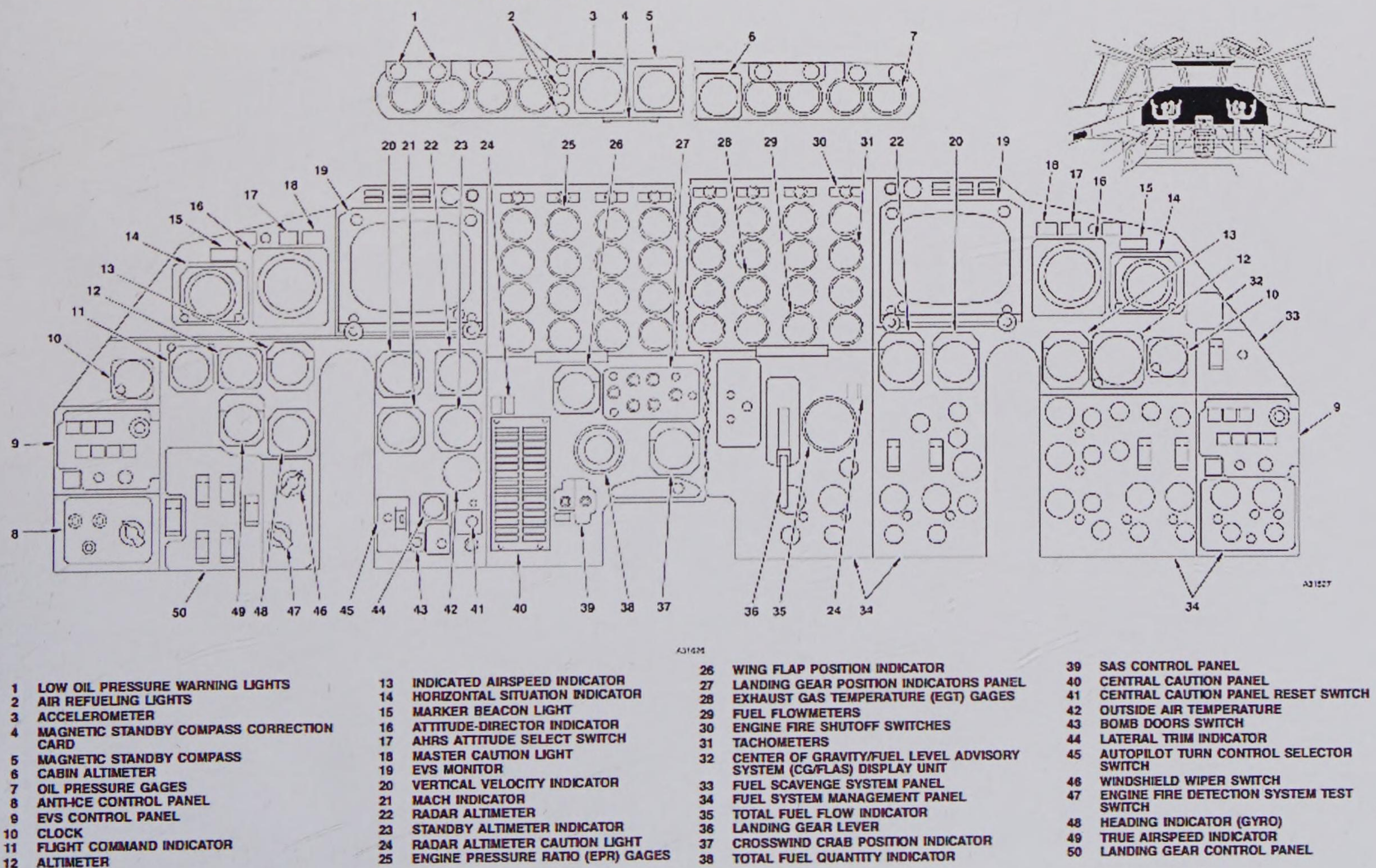


*Two hands, eight throttles! The pilot and co-pilot make sure max thrust is maintained during the takeoff run.
(author)*



Evolution of the B-52 cockpit, with large Multi-Function Displays dominating the instrument panel.

Pilots' Instrument Panel (Typical)



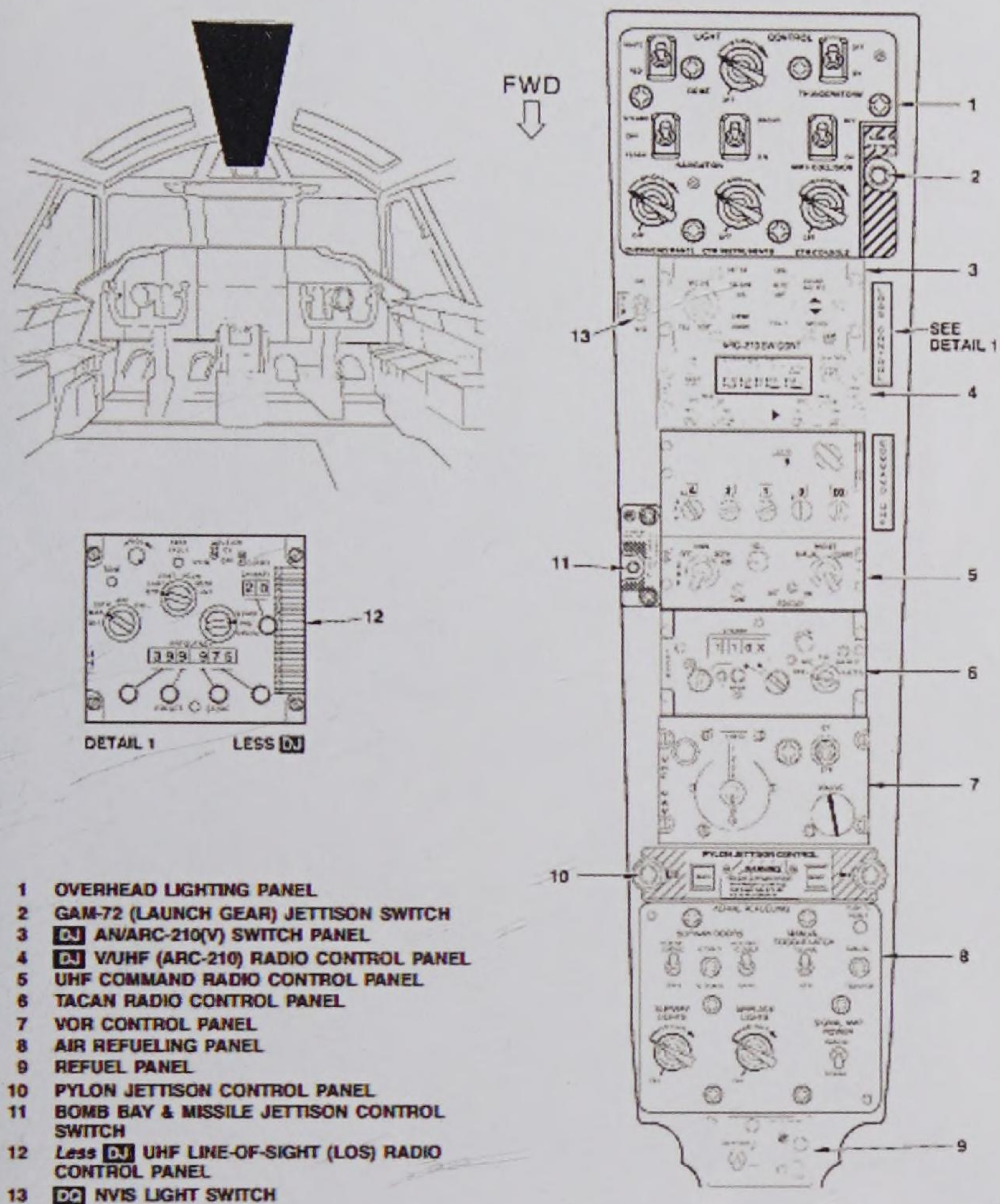


(above) Pilot & Co-pilot sit on upward firing ejection seats.

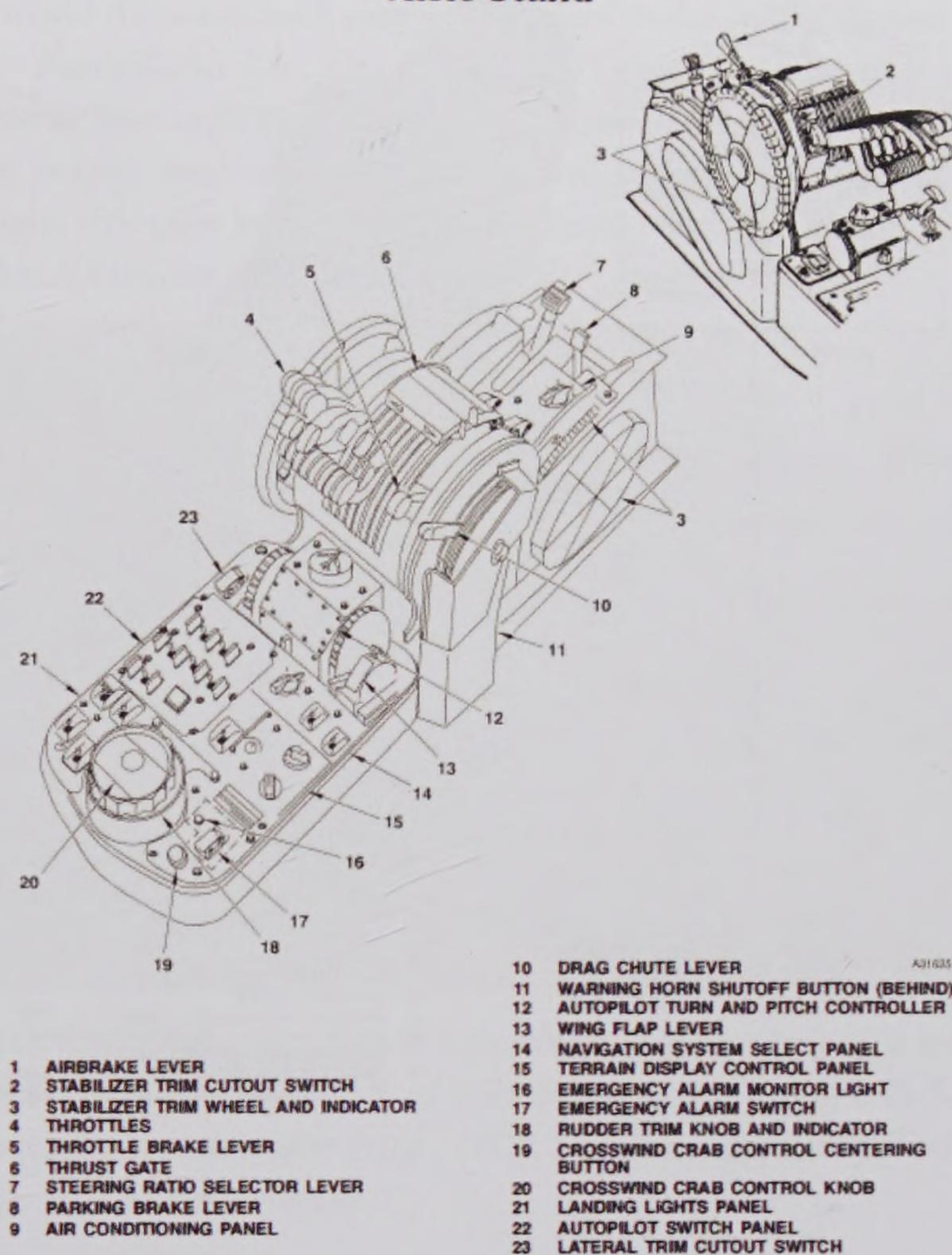
(below) An aircrew assigned to the 96th Bomb Squadron at Barksdale Air Force Base, La., flies a Red Flag-Alaska mission in a B-52H Stratofortress at Eielson AFB, Alaska. (U.S. Air Force photo/Staff Sgt. Christopher Boitz)



Overhead Panel

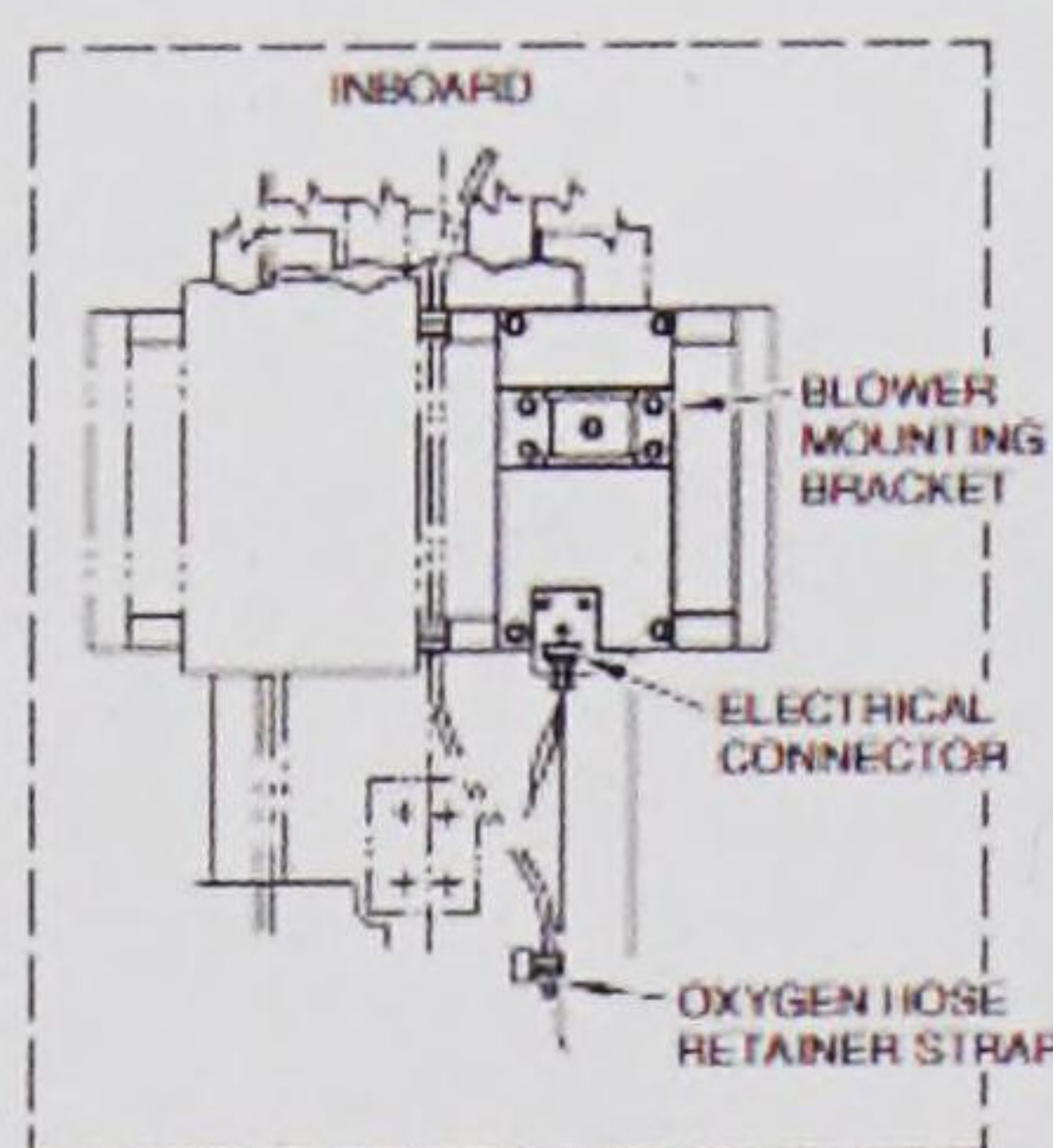


Aisle Stand



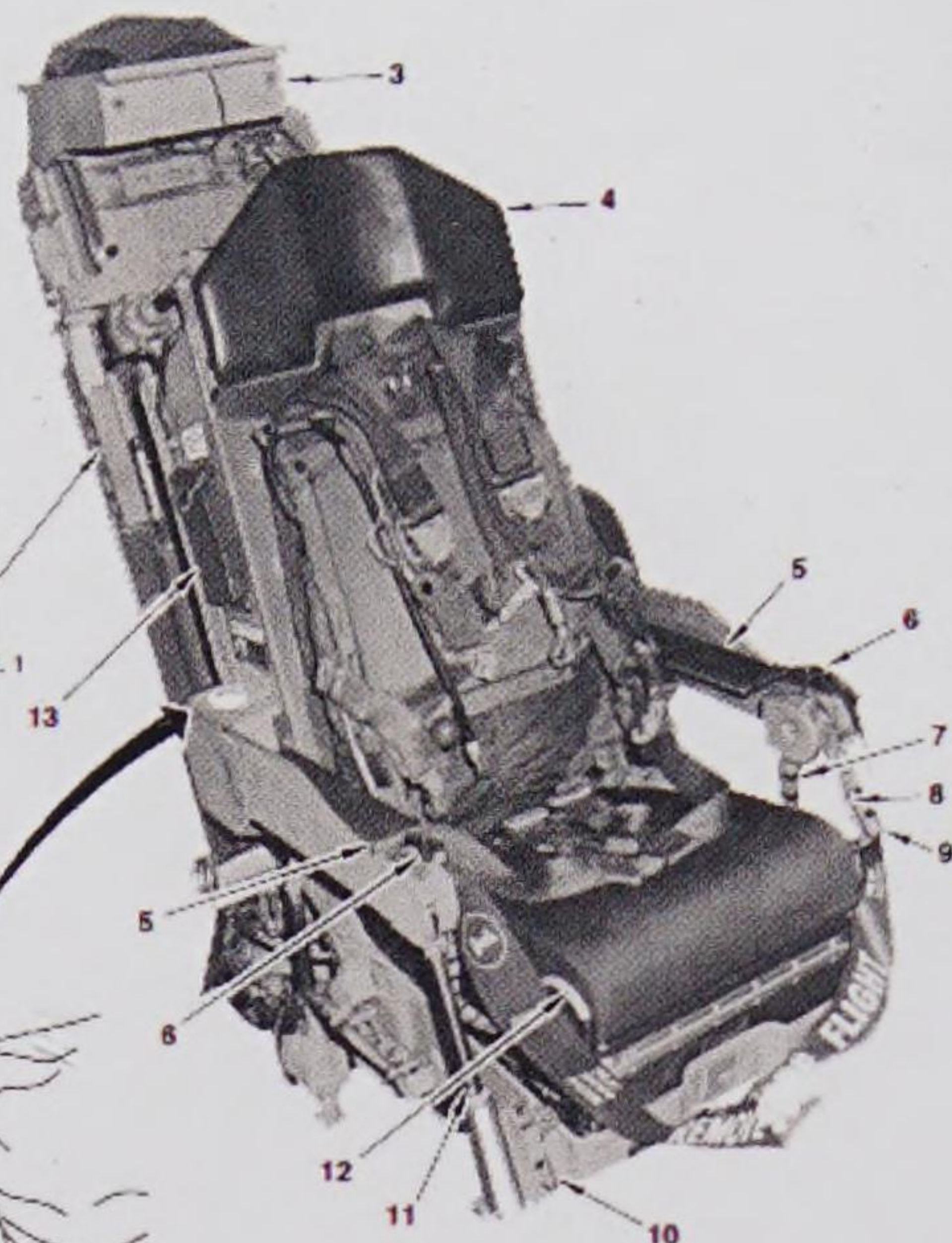
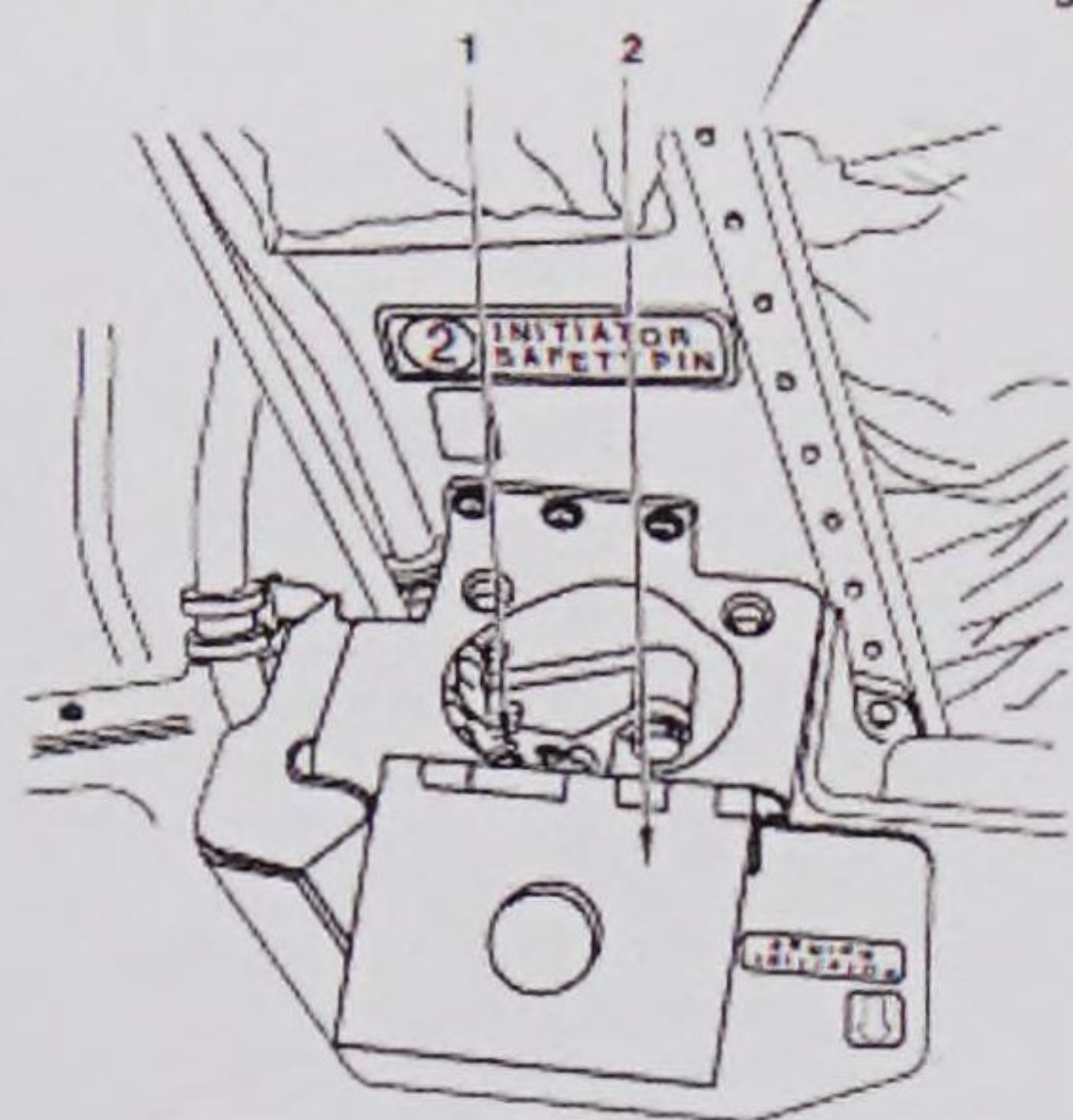
Maj. Chris Weir, left, and Capt. Greg Lepper, 96th Bomb Squadron B-52H Stratofortress navigators, navigate a B-52 during a Green Flag-East training mission over Fort Polk, La., Aug. 21, 2013. GF-E is a realistic air-land integration combat training exercise meant to replicate deployed warfare conditions. (USAF)

Upward Ejection Seat



DETAIL 1

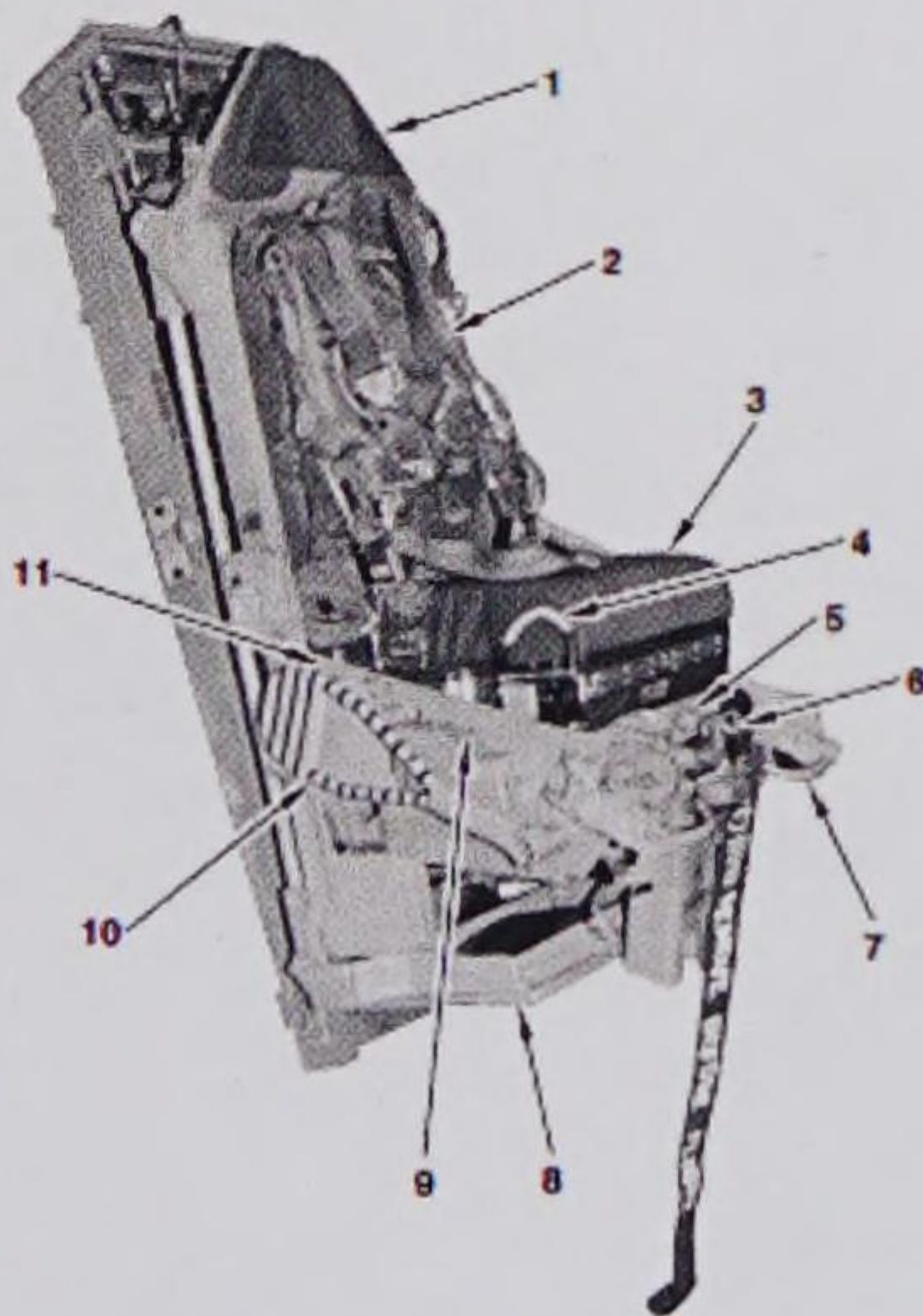
PILOT/COPILOT SEAT



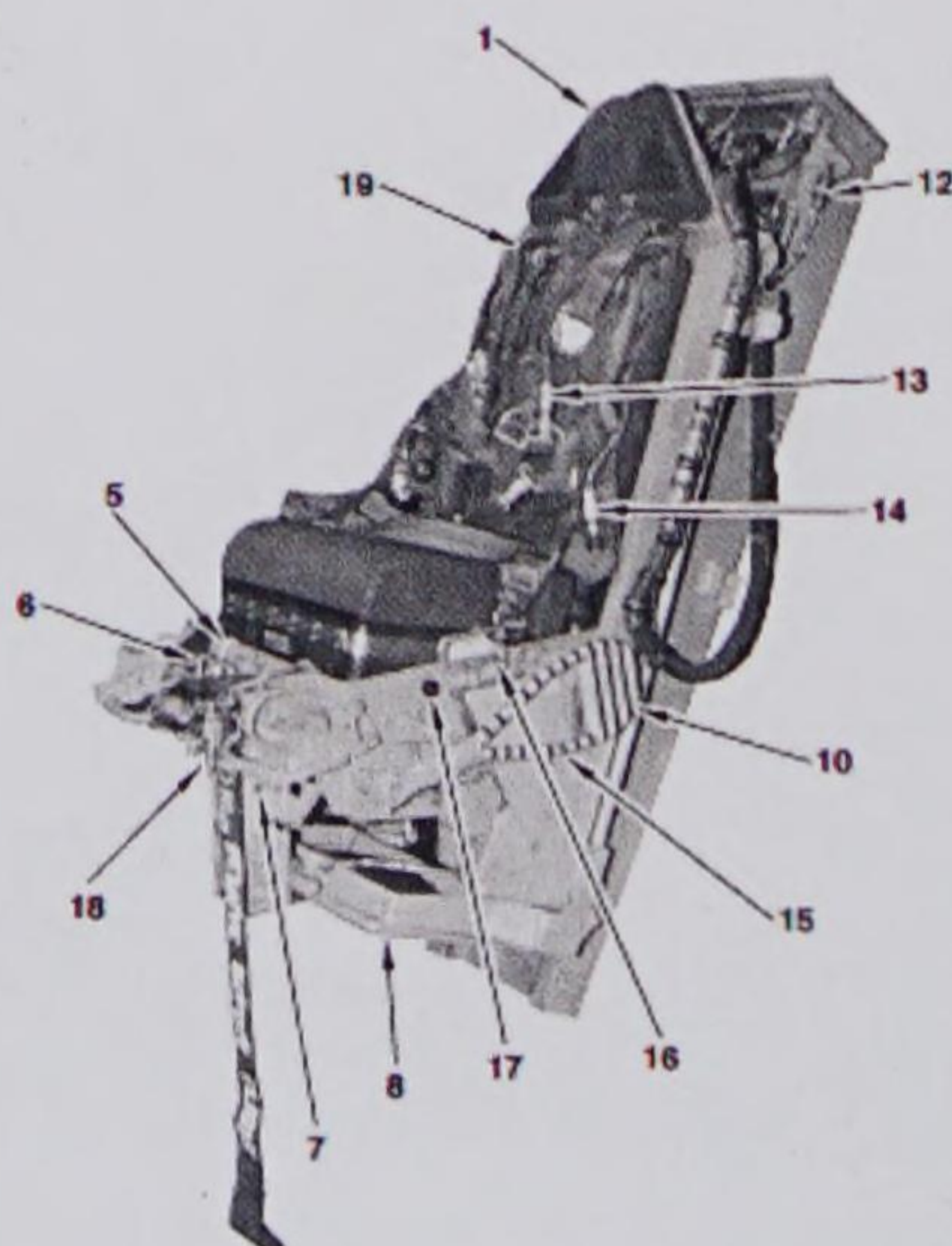
- 1 ARMING INITIATOR (ACCOMMODATES MAINTENANCE SAFETY PIN NO. 2)
- 2 INSPECTION DOOR AND WINDOW
- 3 DROGUE PARACHUTE CONTAINER ASSEMBLY
- 4 HEADREST
- 5 ARMRESTS
- 6 FLIGHT SAFETY PINS NO. 1 (ARMING LEVERS)
- 7 CATAPULT FIRING TRIGGER
- 8 ARMING LEVER RELEASE
- 9 ARMING LEVER
- 10 SEAT POSITIONING SWITCHES
- 11 ARMREST CATCH
- 12 SURVIVAL KIT RELEASE HANDLE
- 13 POUCH FOR NO. 1 FLIGHT SAFETY PINS (INBOARD SIDE OF SEAT BUCKET)
- 14 AERP BLOWER MOUNTING BRACKET AND ELECTRICAL CONNECTOR (INBOARD EJECTION SEAT RAIL OF PILOT'S SEAT ONLY)



Downward Ejection Seat

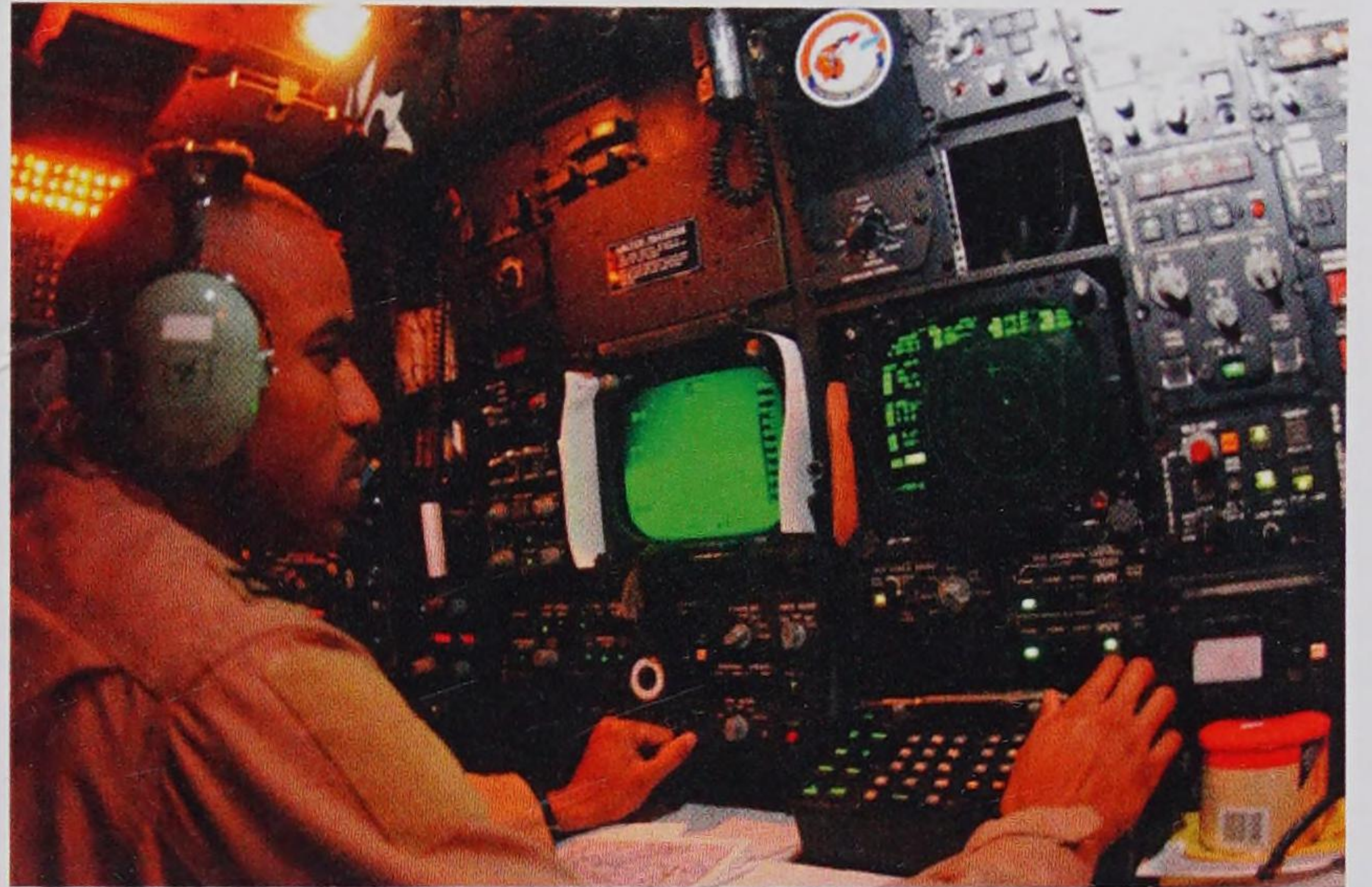


- 1 HEADREST
- 2 MODIFIED PARACHUTE
- 3 GLOBAL SURVIVAL KIT
- 4 SURVIVAL KIT RELEASE HANDLE
- 5 EJECTION CONTROL TRIGGER RING
- 6 EJECTION CONTROL TRIGGER RING RELEASE MECHANISM PIN
- 7 ANKLE RESTRAINTS
- 8 DROGUE PARACHUTE CONTAINER
- 9 SEAT POSITIONING SWITCHES
- 10 LEG GUARDS
- 11 INTEGRATED HARNESS RELEASE RESET BUTTON (BEHIND)
- 12 PARACHUTE CONTAINER ARM RELEASE INITIATOR (ACCOMMODATES MAINTENANCE SAFETY PIN NO. 5)
- 13 RIPCORD T-HANDLE
- 14 PARACHUTE ARMING LANYARD
- 15 MANUAL CATAPULT INITIATOR SAFETY PIN-PULL HANDLE
- 16 INTEGRATED HARNESS RELEASE HANDLE
- 17 INERTIA REEL CONTROL HANDLE
- 18 REMOVE BEFORE FLIGHT SAFETY PIN NO. 1
- 19 PARACHUTE SHOULDER STRAPS

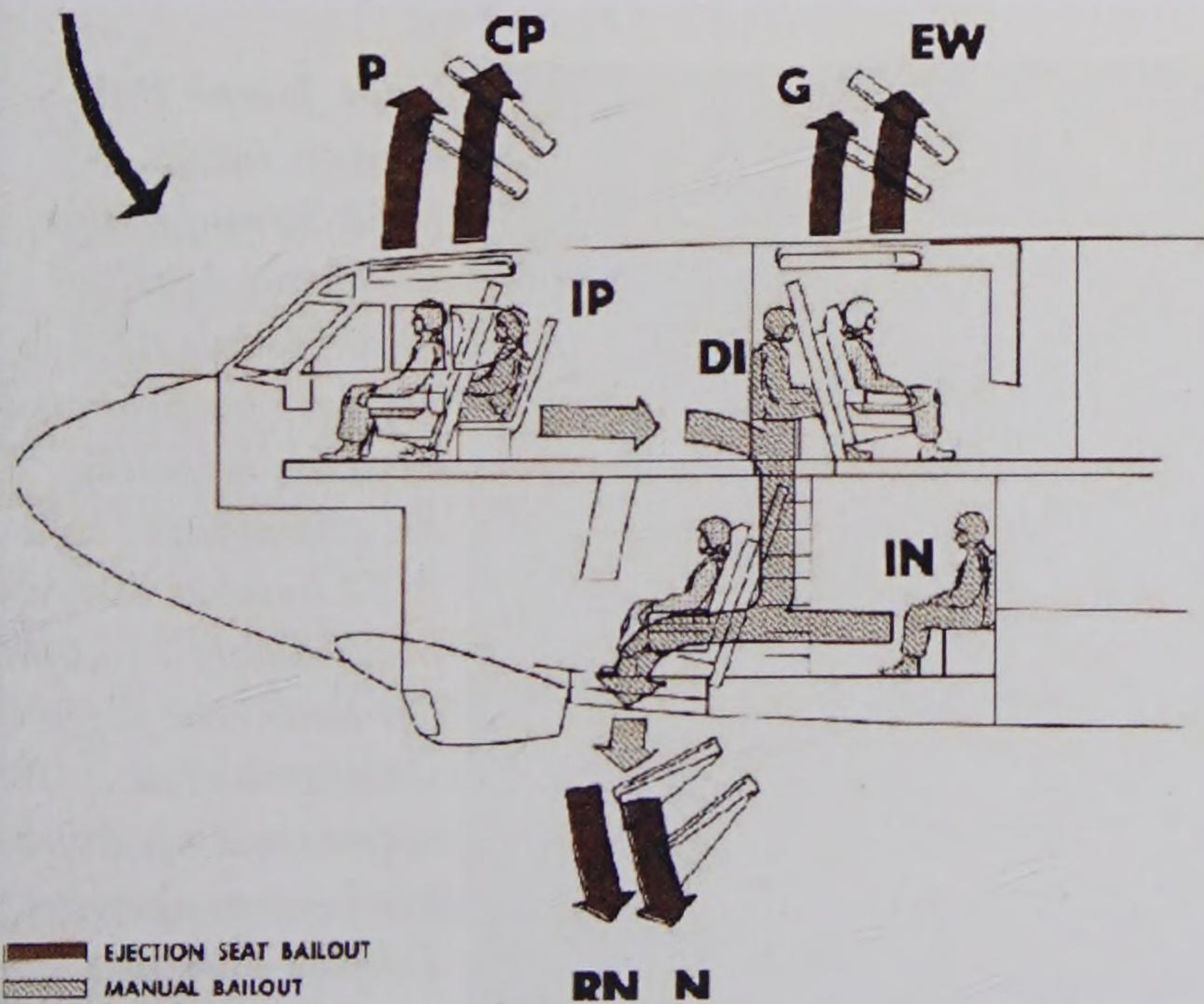




(left) Senior Airman Jeffrey Valentin, left, and Airman 1st Class Jory Billings, 2nd Maintenance Squadron hydraulic systems Airmen, look over a technical order at Barksdale Air Force Base, La., Dec. 8, 2015. TO's are step-by-step instruction manuals used by maintenance Airmen that list proper tools needed, any hazards to be aware of and protective gear to accomplish the task. (U.S. Air Force photo/Airman 1st Class Luke Hill)



40th Expeditionary Bomb Squadron, radar navigator adjusts the Electronic Optical Viewing system during a B-52 bombing mission over Iraq. (U.S. Air Force photo by Tech. Sgt. Richard Freeland)



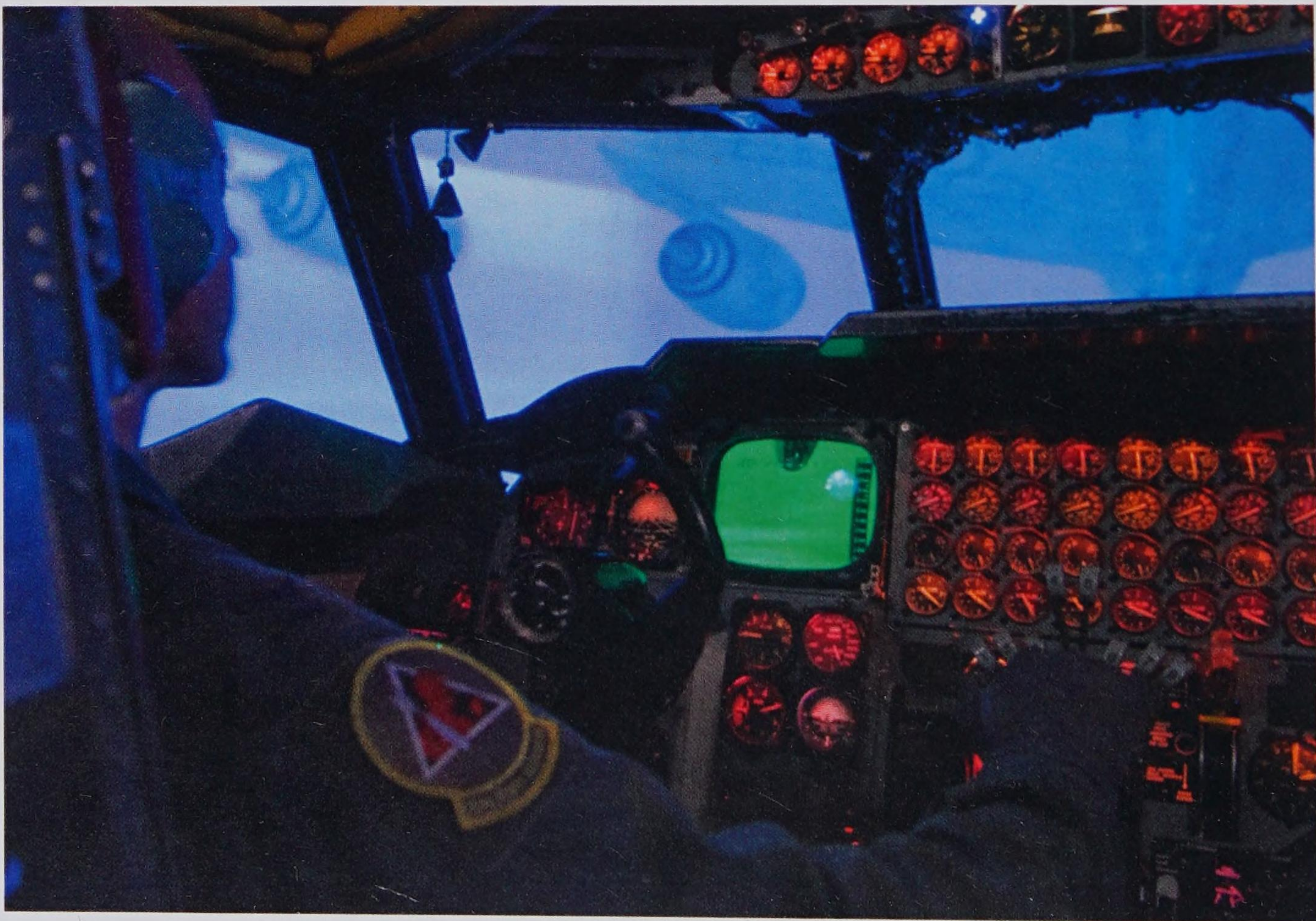
When the B-52G/H had five crew members: Pilot, Co-Pilot, Gunner, Electronic Warfare Officer, and Radar Navigator all rode on ejection seats. When an Instructor Pilot or Navigator Instructor rode along, they did not have ejection seats, and would be expected to exit the aircraft on their own after the RN ejected.



The Radar Navigator sits downstairs in this B-52H. His panel contains flight instruments and weapons management instruments. (author)



Maj. Tim Hines (left) and Maj. Cary Montgomery, 10th Flight Test Squadron pilots, on final approach to Tinker Air Force Base, Okla., for depot maintenance. The crew will then fly the aircraft back to its home station after any work is done. (U.S. Air Force photo/Margo Wright)



Capt. Joseph Babboni trains on a B-52 Stratofortress simulator April 28 at Barksdale AFB to improve his proficiency at air refueling. An actual flight in a B-52 bomber costs approximately \$16,000 per hour. The flight simulator costs approximately \$400 per hour to operate. Despite the cost savings, not all training can be conducted in a simulator. Capt. Babboni is a pilot with the 11th Bomb Squadron. (U.S. Air Force photo/Lance Cheung)



The B-52 was an early participant in the Vietnam War, and the Arc Light missions to deny sanctuary to the Viet Cong and interdict supplies enroute to South Vietnam from North Vietnam were flown often, but not always routinely. Though there was no significant enemy threats to these missions, they could be hazardous, as evidenced in this account of a mission that ended in disaster. The following narrative originally appeared in my book "United States Air Force in Vietnam" published by Steve Ginter.

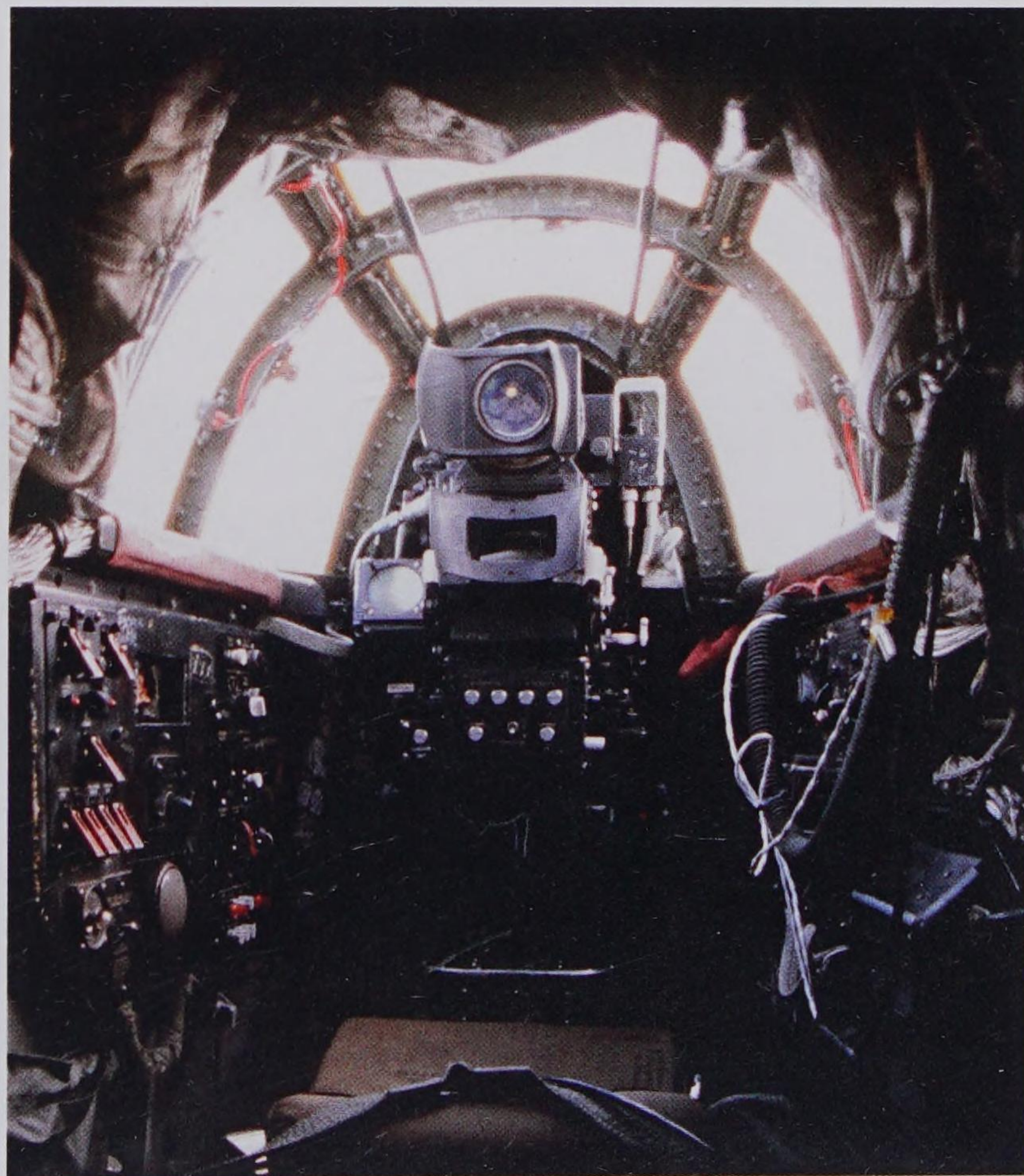
BUFFS DOWN

by Lynn O. Chase

The night was warm and clear on the island of Guam as 6 B-52Ds of the 22nd Bomb Wing lined up for takeoff at 0300 on 7 July 1967. Major John A. Suther was the mission commander and was flying in cell position Red One. Major Suther was a B-52 combat veteran, having flown 34 previous missions. His crew included Co-Pilot Captain Wilcox J. Creeden, Radar Navigator Major Paul A. Avolesse, Navigator Lt. William R. Gable, Electronic Warfare Officer Captain David F. Bittenbender, and Tailgunner Sgt Lynn O. Chase. Flying as an observer in the jumpseat of Red One was Major General William J. Crumm, Commander of 3rd Air Division.

Proceeding as planned to the refueling track, the six B-52s rendezvoused with their six KC-135 tankers. Each B-52 took on 77,000 lbs of fuel from their respective tankers. The refueling was routine, and as they dropped off their tankers, the B-52s joined in their planned visual contact formation (VFC), which was two three-ship formations in as Vs in trail. This

formation was flown relatively close to maximize the effects of their bomb loads, which would be released under radio silence, using pre-set radar offsets. Major Suther evaluated the weather and confirmed that VFC conditions would remain throughout the bomb run. (VFC tactics date to WWII, when daylight bombing was the standard tactic for heavy bombers.) On at least two occasions during the bomb run it was noted that Red Two, flown by Captain George W. Westbrook, had come uncomfortably close to the right wing of Red One.



B-52D tail gunners position.



The B-52D/E/F mounted quad .50 caliber machine guns in the tail.

Shortly before reaching the IP (Also known as turn Xray) for the turn on the bomb run, the MSQ ground site (Which would direct the radar bombing) asked Red One to re-check their SST-181 beacon, which provided the ground site with positional information on the lead bomber. Red One's radar beacon was unreliable, which meant that one of the two wingmen would have to assume the lead position. MSQ notified Red One that he was going to have to switch positions with Red Two for the bomb run.

Red One, as mission commander, interpreted the MSQ instruction to be a suggestion, while Red Two received it as a command. Westbrook immediately advanced his throttles to move forward, assuming that Suther would retard his throttles, move back, and

cross under Westbrook to rejoin on his right wing. The B-52 is not a fighter, and flying it in formation requires considerable technique and vigilance, since visibility is limited. Making this positional change in the middle of the turn onto the bomb run complicated what was already a difficult maneuver. Red Two's fuselage contacted the left wing of Red One, between the external fuel tank and the number one engine pod. The outboard wing section of Red One broke off as it made contact, severing the tail of Red Two. Explosion and fire ensued, initiated by the rupture of the wing fuel tanks of Red One, which was immediately engulfed in flames and went into a left spiral dive. Red Two, sans tail, pitched straight down, diving for the ground.

At the moment of contact, it was immediately apparent what had happened. Major Suther later told me that he had given the order to bail out. I never heard this, nor did I need to! The tremendous explosion and the resulting heat were all that I needed to know that it was time to eject.

I had been flying the tail gunner position for about two years at the time of this incident. I had gradually become quite comfortable back in my compartment, isolated from the rest of the crew. The view was majestic and led you to believe that you were king of all you surveyed. Usually I flew in a very relaxed mode, unstrapped from my parachute, with oxygen mask hanging loose. This day was different. The erratic flying of Red Two got my attention early in the mission, and I was strapped in and cinched up tighter than I had been since graduation from gunnery school. When the collision occurred, my first reaction was to reach out with my right hand and pull myself forward. When I did this, the heat was so intense that it burned the skin off my right arm. I reached out with my left hand to yank the lever that would eject the turret section, allowing me to jump out. This resulted in the skin of my left arm being peeled off by the flames. (I had always flown with the sleeves of my flight suit rolled up, which negated the protection of the nomex suit.) I have often thought since of myself as sitting inside a tin can in a bonfire.

The turret section ejected as advertised, and away I went into the open sky. As I came tumbling out of the aircraft, I started to spin rapidly and remembered what they had taught me about free fall. I extended my arms and legs and gradually got the spin under control. Once I stabilized, I realized that I could not see the ground because of the solid undercast. This



The awesome power of thousands of pounds of bombs raining down from all but invisible high-flying BUFFs struck terror in the hearts of Viet Cong fighters. (USAF)

was a big concern, since I really did not want to land in the middle of the target area. At about 14,000 feet, the parachute opening sequence began. Once under the canopy, I pulled the seat pack release to deploy my life raft and survival kit. Shortly thereafter, I broke through the clouds and determined that I was going to land in The South China Sea. This was really welcome news, since I knew we controlled the sea and I would be picked up soon.

Landing in the sea was a good thing, but as I soon found out, it was also a very painful thing. I inflated my life vest and, as my feet hit the water, I released my parachute risers, allowing the canopy to drift away and not drag me under. I was bobbing up and down in ten foot swells while trying to get into my life raft, while my freshly burned arms screamed in agony from contact with the salt water. I finally did get into my raft, and about a half an hour later, an F-4C flew over me and rocked his wings to let me know that help was on the way. For the next two and a half hours I sat in my raft, throwing out dye marker and watch-

ing for the helicopter that eventually showed up and hauled me aboard. I was taken to an Army hospital in Vung Tau, South Vietnam.

After two days in Vung Tao, I was transferred to the Navy hospital on Guam, where I remained for 30 days while I recovered from the 2nd degree burns on 23% of my body. I was then transferred back to March AFB and assigned a new crew. I did another combat tour in 1968.

Captain David Bittenbender, Major Paul Avolese, and Major General William Crumm, aboard my aircraft, were killed in the collision as well as three members of the crew of Red Two. Major General Crumm was the highest-ranking officer to be killed in the Vietnam War.

Twenty four years after the collision I was reunited with Eric Bittenbender, who was five months old when his father died. Through Eric, my wife Clara and I have established relationships with Eric's mother Kathleen and with Marilyn Avolese.



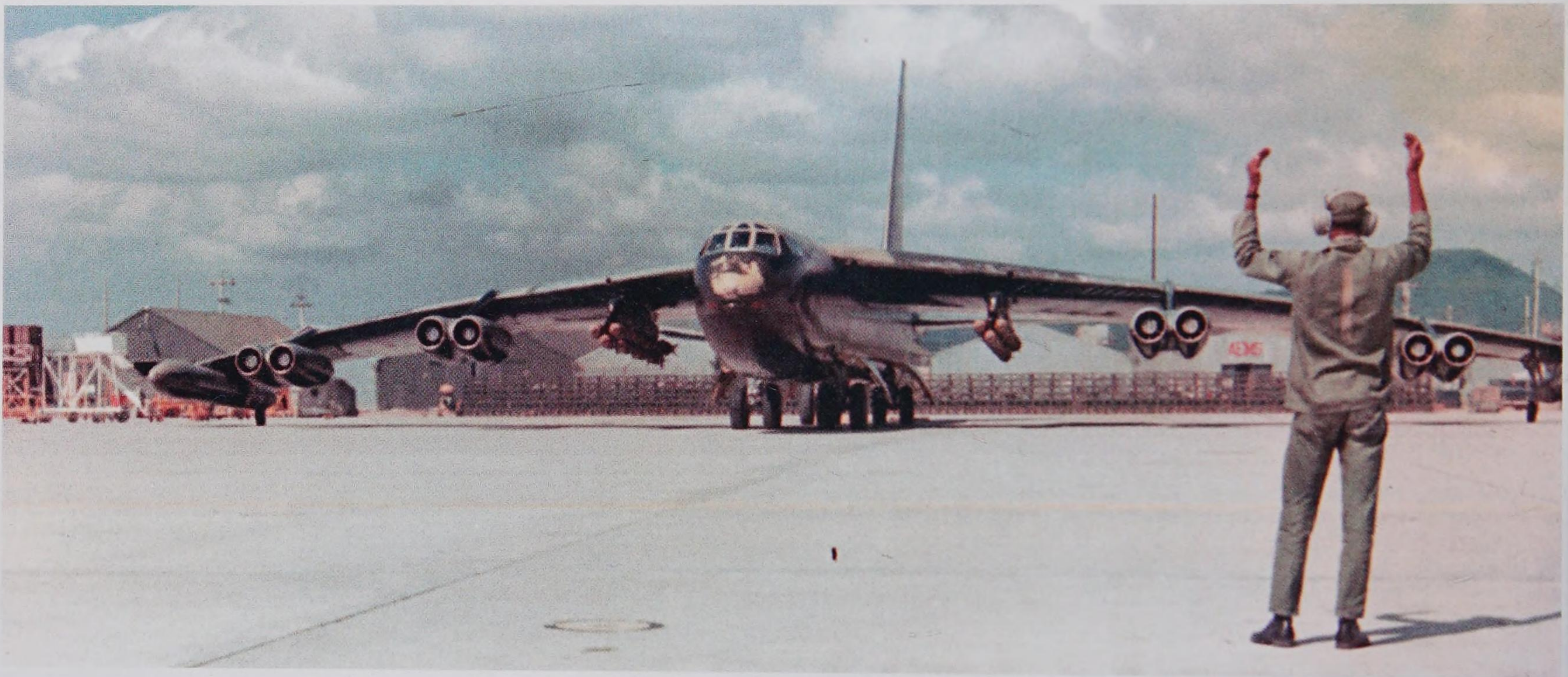
B-52Fs, with black undersides, flew the majority of the early Arc Light missions. When the B-52D got the "Big Belly" bomb capacity, the F reverted to its nuclear mission. (USAF)



Crew of B-52F-70-BW 57-0170 walks away from their bomber at Andersen AFB, Guam after their 32nd Arc Light Mission. (USAF)



B-52F-65-BW 57-0144 "Mekong Express" was the 6th F model off the assembly line. (Charles B. Mayer)



A crew chief waves a fully-loaded B-52D out from its parking ramp. (USAF)



B-52D-35-BW 56-0677 was the only B-52 on Guam to feature a shark mouth.



The B-52 bomb load was increased with the addition of underwing pylons capable of mounting a dozen additional bombs. (USAF)



The bomb clip system in the Big Belly B-52D allowed armorers to quickly reload the bombers during the intensive 11 day Linebacker II operation. Considering the length of the missions, there wasn't a lot of time to turn the bombers around. (USAF)





Linebacker II

After 17 years of SAC service, the B-52 finally laid to rest any doubts which might have lingered about its ability to perform the strategic bombardment mission. During 11 days in December of 1972 the B-52s penetrated the strongest air defense network ever encountered in the history of aerial warfare to put their loads precisely on target.

The targets were military and industrial complexes in the Hanoi/Haiphong area of North Vietnam. They were struck as a result of a continuing intransigence and faithless bargaining position of the enemy at the so-called "Paris Peace Talks", and to demonstrate to the enemy that the United States had the means and the will to do whatever had to be done to negotiate the return of POW's, and an end to hostilities in Southeast Asia. That the enemy was in the end dishonest in his signing of a so-called "peace agreement" demonstrates beyond any doubt that if he had had the means to effectively resist the aerial onslaught of Linebacker II, he would have done so. For 11 days out of 11 years, the United States was anything but a paper tiger, as bombs rained virtually around the clock on the enemy homeland.

In researching my original "B-52 In Action" (Squadron/Signal Publications, 1975) I got the full SAC briefing at SAC HQ, Offut AFB, Nebraska, then flew on to Blytheville AFB for my B-52 orientation ride.

While at Blytheville AFB, Arkansas, I interviewed Brigadier General James R. McCarthy, who was then commander of the 42nd Air Division. During the Linebacker II campaign he was Wing Commander of the 43rd Strategic Wing, based at Andersen AFB, Guam. He was one of the planners of many of the B-52 raids during that campaign and won the Air Force Cross as Airborne Mission Commander, flying in the lead bomber, on the spectacular mission of 26 December, 1972. These are his recollections of the Linebacker II campaign:

"I think if you really want to see the significance of these

raids, from an airmanship standpoint, you have to go back in history and compare them to some of the big raids of World War II. For the Ploesti raid, as an example, a complete mockup of the target was built in the Libyan desert, and the bomber crews practiced, practiced, and practiced. Our raid of 26 December 1972 employed improved tactics. We had never practiced them at all. (Author's note: In many of the big raids of World War II, such as Ploesti, Regensburg, and Schweinfurt, losses of 20 to 30% were experienced. The overall Linebacker II losses were about 2 %.) The tactics were very complex, and the timing was plus or minus zero. Normal SAC crew training is plus or minus three minutes. This had to be zero. From that standpoint alone . . . to go up and do it the first time around, without ever having had the benefit of practice, and to do it with some pretty junior, inexperienced guys flying, was pretty fantastic. As an example, I had one pilot who, on his fourth mission as an aircraft commander, flew this mission . . . at night, over North Vietnam. That's calling for a hell of a lot out of a guy, and he did it, and did a fine job!

There was a lot of controversy about whether you should be allowed to maneuver or not. A B-52 is not like an F-4, for example. With an F-4 you could tuck it in close and fly a pretty good formation while maneuvering. A B-52, on the other hand, is very hard on the controls, so it takes a lot of physical power and coordination to wrassle it around the sky . . . sort of like driving a Mack Truck. On the third night, we really got zapped bad, so as a concerted effort the command developed new tactics. We had been attacking from the northwest, down Thud Ridge. After hitting the target, we would make a hellacious turn to get out of the area. That gave us the minimum time in the lethal SAM zone. When an area is as heavily defended as Hanoi/Haiphong was, the lethal zone was pretty large. Naturally, you don't want to spend any more time in that environment than is absolutely necessary. Well, all of our losses seemed to stem from that big turn, so tactics which eliminated the big turn wherever possible were developed. (Authors note; Another bone of contention was the fact that these "new" tactics were not introduced until the sixth night of the 11 day campaign. This was not due to any lack of insight on the part of the commanders. It



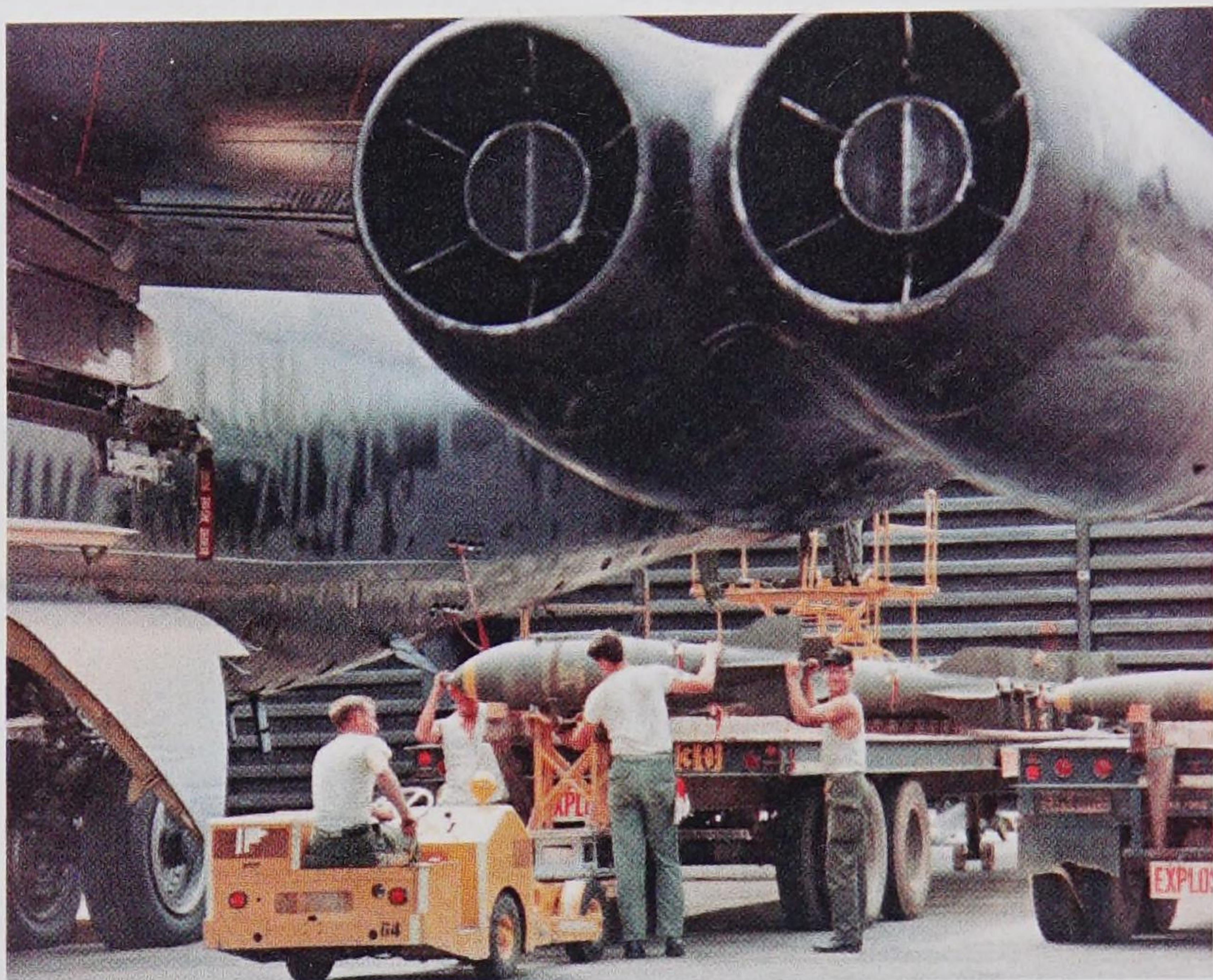
was more a result of the length of the missions. For example : The mission of the 19th would only be returning when the mission of the 20th was taking off. The distance from Guam to Vietnam made these some of the longest, if not the longest in the history of aerial warfare, sometimes lasting up to 18 hours. The 20th mission would be well on their way to the target before the previous day's mission had debriefed. This, in effect, doubled the lead times needed to change tactics.) Well , we knew we had to do something about that big turn , and we knew we had to stop driving in the same way every night. After all, those radar operators could just about draw a grease pencil line on their scopes, they knew our routes so well! The 36 hour stand-down for Christmas gave us the breather we needed to come up with new tactics.

The tactic that SAC came up with was for four wave of B-52s to hit four targets which were relatively close to each other in the Hanoi area, while other B-52's attacked targets in the Haiphong area. All of these attacks were to be carried out simultaneously. Many of the older B-52D models struck the heavily defended areas around Hanoi. This was ironic, and I can recall thinking as we flew up that night how thankful I had been, back in 1960, when I transitioned to the B-52 , that I was flying the B-52E instead of those tired old D models. And here I was, taking four waves of those old D's, twelve years later, to the toughest targets we had ever attacked! Another change we made that night was to vary the altitudes we flew at. We were attacking the Hanoi railyards, while the wave which came in from the northwest was attacking a target just three miles

away! True, they were at a different altitude than we were, but we were attacking simultaneously. The targets being struck by the two southern waves, one from the southeast and one from the southwest , were only seven miles away, and they too were being struck simultaneously. The biggest fear we had was one of the bombers in the high waves being hit and falling through our wave.

At this point I'd like to go back to the beginning of the Linebacker II campaign. It was eight days before Christmas, and a lot of the crews were scheduled, through normal rotation, to go back and spend Christmas with their families. In addition, we had worked out a plan whereby we could send extra crews home by doubling up on some of the flying. Well, when the word on Linebacker II came down, I had to call a meeting of all of the aircraft commanders. I told them that everyone was restricted to the base, that they were not going home, that they were not allowed to make any telephone calls, and that we were going to fly some extremely important missions.

Well, I had seventy-some crews, and as is normally the case, four of five were DNF (Do Not Fly) because of colds or sinuses, or other minor ailments. The first question I got after breaking the news was ; "Sir, those of us that are grounded ...do we have your permission to try to talk the flight surgeon into letting us fly?" Well, that showed me a lot, and before the campaign was over, they gave me many more reasons to be proud of them. There were three B-52 wings participating in Linebacker II. The 43rd , which I commanded , the 307th , which was based at Utapao RTAB , and the 2nd , also based at Andersen.



(above) Loading 750 lb. bombs on a B-52D. "Big Belly" D models could carry up to 42 of these. (USAF)

The 43rd and the 307th were the "D" wings, while the 2nd flew the "G" models. During the entire operation, I did not have one guy who refused to fly, and when it was all over, we had the lowest loss rate of any of the B-52 wings. Naturally, we wanted to know why, and conducted a "monday morning quarterback" session after the campaign was over.

(Authors Note: When this account was originally published the mutual protection was afforded by on-board ECM carried by the bombers, and the formations they flew. The protection came from the massed jamming of the formation, which created jamming signals that confused the SAM guidance radars. This was a closely-guarded secret at the time, and some of the information contained in my original interview was redacted. Additionally, the B-52-D models had a more complete suite of ECM jammers than the G models. Their loss rates were correspondingly lower than the newer B-52Gs.)

"We had stressed mutual protection, distaining the hellacious types of maneuvers some guys were making in an attempt to dodge the SAMs. You can't dodge a SAM. At least, not in a B-52. A lot of guys thought they could, and a lot of them tried. But we stressed basic air discipline, keeping the formation together. This takes a lot of guts, because the miss distance the system is designed to give you makes it virtually impossible to tell if the SAM is going to fly right up your nose, or miss you. So for a bomber pilot to keep boring in, straight and level when the SAMs are all around, takes a lot of intestinal fortitude. That's not the same as a fighter. In a fighter, you could wait until the missile was within about a click of you, then break down into it. In a fifty two you couldn't do that...the airplane couldn't take much of that kind of G force. So I told my troops: "If you break formation to dodge a SAM, I'll court-martial you!" Now, that didn't go down too well at first, but after about four days they were coming to me and admitting that it was the best way we were losing

less airplanes, and getting our bombs on the targets better. Now, if a guy starts dodging SAMs, he not only highlights himself, he degrades the ECM effectiveness of the formation. We recovered one crew that was shot down, and the pilot admitted that he had been breaking left every time a SAM was fired at him. The first night he got away with it, and thought he had the answer. Well, on the third night the SAMs were heavier, and he kept breaking left until he was about five miles out of the formation. He got zapped.

Now, we did maneuver some, but it was a very gentle maneuver, and it kept the formation together. One of the advantages of the D model manifested itself here. We gave the tail gunners Aldis Lamps, and with their radar they could pretty well tell where the trailing bomber was. When we maneuvered, the gunner would flash his lamp to let the following B-52 know which way to turn. And, if we kept the formation together, the burner cans of the eight engines were visible to the trailing B-52. This made a great attitude indicator, and we got so that we could make these maneuvers and still keep the formation intact. This was no mean feat, since many of those nights were moonless, and a lot of the guys were relatively low-time pilots. (1200 hours total time, with maybe 300 in the B-52) Now, you expect that kind of flying from a guy with four or five thousand hours, but to get it from inexperienced pilots is really fantastic! I attribute our success to their training, their native intelligence, and to their attitude. As for that training; at Andersen we had a requirement for two "over the shoulder" missions, one in the day and one at night, with an experienced aircraft commander and radar navigator, to make sure that he had the procedures down, before we let them go as aircraft commanders on their own. That was if he was doing good refueling. A lot of the G and H model pilots had trouble transitioning to the D. It was a much harder airplane to fly, particularly with bombs hanging on the external racks. And it had less power than the G and H models, so the average guy might take three or four missions to get qualified in the D.

There was a significant change in attitude as the campaign progressed. Initially, I had a lot of guys come up to me and say; "Colonel, I don't mind telling you . . . I'm really scared!" "I'd have to tell them; "Don't feel like the Lone Ranger, friend!" And here is where the value of having the wing commanders fly the missions really paid off. I'm from the old school. I believe a commander should be in the thick of it, leading his troops. We, as high-ranking officers, had a lot of information that the enemy would dearly have loved to get and, normally speaking, we should never have been allowed to fly. But we discussed it, and decided that the value of the information was not as important as the morale factor which our flying would have. On every mission that we launched, we had an airborne mission commander, who had to be a full colonel, and a deputy airborne mission commander. We took our turns on these missions, the duties being split between the Wing Commanders, their Vice Commanders and the DCO's.

The low point, attitude-wise, was just before the Christmas stand-down. We had lost a lot of airplanes, and then giving



Flying missions to Vietnam from Guam required multiple aerial refueling for the 12 to 14 hour missions. (USAF)

the enemy a chance to get set for us on the 26th really had the guys worried. But our tactics were more effective than we could have hoped they would be. By the night of the 28th we noticed that the SAMs were far less accurate. They would launch them in salvoes, and they appeared to be unguided, coming up and going every which way. By the 29th the crews were saying; "Don't stop now! We've got this thing won. Another week of this, and we can go up and do it in the daylight!"

The pilot of one of the crews who was shot down, and later recovered, told me how he was shot down. They were within seconds of bombs away when they picked up the SAM launch. This was the most critical part of the bomb run and they knew if they wavered, their bombs would be off target. They had all of the electronic indications that the SAM was indeed aimed at them, and in fact, they picked it up visually. It never wavered for a second... its relative position in the windscreen was constant as the rocket motor exhaust grew larger and larger. They knew it was going to hit them... in fact, one of the calls on the intercom just before it hit was; "This one's gonna get us!" It did. Just after bombs away. But they put their bombs on the target, and that's what I call "guts football". Fortunately, they were able to bail out, and were recovered later. The tremendous attitude of the crews was matched by the support people. Many times I saw bomb loaders or maintenance men work their own shifts, then stay on to help their buddies on the next shift. And when we took off on those missions we often had 15,000 airmen out there on the line, cheering us on. It was a tremendous team effort, and I can't tell you how impressed I was by those young kids who, sensing the importance of these missions, and knowing how many lives were on line, really worked their hearts out for us. It was a historic chapter in aerial warfare, and I'm glad to have had the chance to participate.

The mission of 26 December, 1972 was a turning point in the Linebacker II campaign. It was a turning point for the B-52 crews because the tactics greatly enhanced their effectiveness, allowing them to penetrate the enemy defenses with less chance of getting hit. It was a turning point for the North Vietnamese because it delivered a psychological blow that they were not equipped to handle.

The B-52 had long been one of the most feared weapons

by the North Vietnamese. Colonel Robinson Risner, a POW of the North Vietnamese for seven years, stated that the enemy was not afraid to fight the fighter-bombers. The fighters came in low. They could be seen, and the enemy could fire at them with small arms. Even if they didn't hit the fighters, they could see them and they felt they were able to resist. The B-52's came over at night, and at high altitude. Often the enemy never knew he was under attack until the bombs started falling. And the bomb load of a B-52 is awesome. (Up to 60,000 lbs in the D model.)

On the night of 26 December, 117 B-52's hit their targets within 13 minutes. It was a cataclysmic experience for the North Vietnamese. One of the POW's later told General McCarthy that he had observed an enemy guard during the raid. The guard was standing in the compound staring at the sky. He had dropped his rifle and was shaking like a leaf, and he had wet his pants.

Major William F. Stocker flew the lead B-52 on this raid, and he was awarded the Silver Star for leading the mission. I interviewed him at Offut AFB, and these are his recollections of the mission; "During the Christmas stand-down we didn't really know if we would have to go back to war or not. We were all hoping that they would get together at Paris, and come up with some sort of an agreement. On Christmas night General (Colonel at the time) McCarthy invited several of us to his home for dinner. We all enjoyed a real nice dinner, and we were relaxing over a drink afterwards, when the guests began to thin out. General Anderson was the first to go. He was the Division Commander, and we were still pretty busy recycling aircraft and crews, so we didn't think much of it. Then Colonel McCarthy got up and announced that he was going to have to leave also. He urged us to stay as long as we liked, and to help ourselves to his bar... "All except you, Stocker. You're coming with me."

When we got outside he broke the news to me that we would be going back to Hanoi the next day, and that I would be leading the mission and he would fly with me. He asked me to go down to the D.O.X. (the planning area), and to look over the mission proile. If I saw anything that should



be changed, I should get back to him and iron it out.

I'll never forget the feeling of incongruity as I worked with the planners that night. I had dressed for the social occasion, and was wearing white slacks and shoes and a brightly colored shirt I had had made in Thailand. I was a sharp contrast to the uniforms around me, and the contrast highlighted the urgency of this mission.

The complexity of the actual attack created heretofore unheard of logistics problems. The number of airplanes going required a massive logistics effort. We had never sent a raid that large at one time, and we didn't have a briefing room large enough to hold all of the crews. As a result, we had to use several facilities, and the briefers had to go from one to the other, giving their portion of the briefings. Food service had never had to prepare that many flight lunches at one time, and they really had to work long and hard to accommodate all of us. Just to taxi that many airplanes at one time ...to keep them all in the proper sequence, and to make sure that spares were in position to go if an airplane aborted, was a major feat of planning.

Normally, we made a rolling takeoff, turning the corner from the taxiway and starting right into our takeoff run. But since I was leading, and they had sterilized the runway, allowing absolutely no traffic, I requested permission to taxi into position and hold, awaiting my time out. They granted it, and in the minute or so before we took off, I was treated to the sight of one of the most awesome armadas ever assembled. As far as we could see there were B-52's lined up nose-to-tail. It's difficult to describe the feeling of leading such an array of power.

Shortly after takeoff, I heard a good friend of mine, who was trailing me on the launch, call an emergency. Captain Jerry Goodman called in with two engines on fire. Naturally, he had to abort, but the ordeal of the next few hours matched anything he would have gone through in the target area. He was diverted out over the ocean to burn off fuel and get down to minimum landing weight. (We had no provision for dumping fuel.) During his orbit the other two engines on the same side caught on fire, and he had to shut them down. He got permission to jettison his bombs into the ocean, and did so. As is so often the case, one problem was compounded by another shortly thereafter. As he was cranking in the rudder trim to hold against the four dead engines, it broke! This is very rare...I had never heard of it's happening, but our airplanes were old, and the corrosive atmosphere of Guam didn't help in trying to maintain them in top condition. He and his Co-pilot adjusted their seats for maximum leverage, and between them managed to stand on the rudder pedal hard enough to keep the airplane flying straight. (Not an easy job ...there is at least 80 to 90 pounds of pressure.)

The people at Andersen talked it over and, considering the possibility of his dinging it on the runway, and concerned about all the returning airplanes they would have to recover, decided it would be best if he bailed out and let the airplane go. Jerry argued against this and convinced them that he could land it safely. When he was down to minimum landing weight, he began his approach. (Minimum landing weight in the B-52D is 280,000 pounds.)

At one time it had been considered a real bad idea to try to land the B-52 without flaps ...there just didn't seem to be enough runway available to get one stopped without them. But eventually someone had to try it, having had an engine blow up, which damaged the flaps and made them inoperable. After he got down, he reported that it was not nearly as bad as it was made out to seem, and that if he had to land with three or four engines out on one side, he would prefer to do it flaps up, since he would have less drag and more power to work with. Well, they did some studies on that, and decided that he was right. The technique was installed as an optional procedure. Jerry was flying a D model, which has less available power than any of the B-52's. The book says it doesn't have enough power with four engines out to make a go-around, if you get below 2,000 feet AGL. On his first approach, Jerry was too high and too hot, but rather than force the landing, he coolly made the decision to go-around before he descended below 2,000 feet. On his second try he got it down and stopped safely. He was awarded the Distinguished Flying Cross for a superior piece of airmanship.

We had a set air refueling area which, due to political considerations and civil air routes, could not be changed. In all of our previous missions the position of the sun had not been a problem or, if it was, the area was large enough to allow slight alterations of the tracks. But with a strike this large, there was no room for maneuver, and we were forced to refuel into the sun. I had anticipated the problem and had made myself a cardboard



shade, with a window cut in it, to block out the sun. By leaning a bit to one side I was able to get my gas without too much trouble, but we were very concerned about how the young crews would handle this situation. Well, they handled it tremendously well, and I didn't have a single plane that didn't get his gas. A little by-play that occurred during the launch illustrated the size of the force, and the time required to get it airborne. As I was in departure, a commercial airliner called Agana Approach Control. (Agana is the commercial airfield on Guam, and was the only other concrete available, so they were holding it open in case of emergencies.) His conversation went something like this ; "Agana approach, this is Pan Am flight so and so. Request landing instructions, over." "Pan Am, this is Agana. Descend to one zero thousand, proceed south and orbit at 70 miles, 180 degree radial, Agana, and say your endurance fuel." "Agana, this is Pan Am. We have...ah...31 1/2 hours fuel ...Do you have an emergency? ...How long a delay can we expect?" "Pan Am, this is Agana. You can expect up to a 3 hour delay. No emergency. Tactical considerations!" His reaction was spontaneous, and unprintable .

Our first big decision on whether to abort the mission was caused by tanker problems. A tanker cell which was supporting the bombers was delayed twenty minutes because of an emergency situation at Kadena. By all rights, this should have caused a mission scrub for one or two of the bomber cells. We felt that, going up against the targets we were attacking, it was of the utmost importance to have all of our briefed bomb tonnage . We had taken off one minute apart, five minutes between cells, (three aircraft) in order to spread the force out for refueling . After refueling we had to fly a complex series of boxes, which took about an hour, to get the force back together. The twenty minute delay on the aborted tanker cell could have been enough to destroy the timing . (Authors note : Remember that 117 B-52's were over their targets within 13 minutes , which required exquisite timing.) Well, we did some quick and dirty flight planning, and Colonel McCarthy ordered the second wave leader to adjust his refueling schedule to rendezvous with follow-on tankers. It worked and the aborted tanker cell finally made it off and took the 2nd wave leader's instructions to complete an effective offload. The second wave leader was Major LeBar, and it is to his credit that he got his cells refueled and back into the stream at the proper time, and in the proper sequence .

The force was together now, and we chased the setting sun westward . When it finally went down , we were confronted with a beautiful, clear, starry sky .

After nearly six hours of flying, we finally reached the coast of South Vietnam , and turned northward . As soon as we passed the DMZ, we began to get indications on the ECM gear that the enemy radars were looking at us, so we knew they would have ample warning in the target areas . We were flying almost due north, splitting the Gulf of Tonkin. I looked out the right front windscreen, and there was Hainan Island lit up like a Christmas Tree . I said ; "Gee, we're awfully close to that dude! I was thinking out loud, and I remember that when I had flown my 100 F-4 missions, we had always avoided Hainan because the Chinese would launch Mig-19's out of there to engage us if we got within their controlled airspace. The Navigator must have sensed my concern, because he came back with ; "Naw , we've got plenty of room". Out in front of us was the coastline of China. It too was lit up, and you could pick out all the little coastal towns , gleaming like a string of gems in the clear night air .

On our left was the coast of North Vietnam and, as we watched , we could see that the F-111's and A-6's had begun their attacks on the SAM sites . All of a sudden, you would see a flare-up of AAA , then the bombs would go off . I





knew their times on target, and as I consulted my watch, it was comforting to note that they were right on time. The Navy had guaranteed us that they would keep the SAM sites around Haiphong busy. We had replied with; "Fine, but don't work them over too hard.....they're lousy shots, and if you get them all, they might be replaced by someone who is better!" We cut short of the Chinese coast and headed inland. When we got to the northeast railway, we cut to the south and headed for our target, which was the Hanoi railyards, right across the street from Gia Lam Airport. We could really tell when we had reached the SAM lines, for they started coming up almost faster than we could count them. A SAM launch at night is quite a sight. There was a low undercast, so we couldn't actually see the ground. What we would see was a flash of light under the clouds, which was greatly diffused and spread by the clouds. It was almost like an explosion. Then, pretty soon, you would see this ball of fire come up through the clouds, accelerating at an amazing rate. You knew then that it was a SAM. What you didn't know, and often couldn't tell until it was too late, was whether or not it was ticketed for you, and, because of the convergence of the different waves, there was a startling number of them visible to us. I was pretty busy flying the airplane and keeping the cells together with the radio, so I didn't have time to get too worried about them. Colonel McCarthy, riding in the IP seat just behind and between the pilots, had time to count them...for awhile. By the time I made my 180 seconds to bomb release call, he had counted 26 in the air, visible to us- in the windscreen. He gave up after that. ...they were just coming up too fast. We saw some triple A, but it really didn't concern us too much...it just wasn't that accurate. In fact, we were almost glad to see it. For some reason, they never seemed to fire AAA and SAMs at the same time, so when we saw the AAA, we knew we were getting a breather from the SAMs. They came close though. One that we didn't see coming couldn't have missed us by more than ten feet. It was just suddenly there and gone, but for a few seconds it was literally as bright as daylight in the cockpit. We were just damn lucky that the thing apparently malfunctioned and didn't go off when it was supposed to.

The intercom communications during the bomb run and just before and after made an interesting contrast with the first few missions. When we first went to Hanoi, getting a SAM shot at you was enough to raise everyone's voice a few octaves, and often you would hear the EW blurt out

something like: "PILOT! SAMTWELVE O'CLOCKTHREERINGS- COMINGTHISWAY!!!" On the night of the 26th, I remember a call that went something like this; "Uh...Pilot, SAM...five o'clock, three and a half rings...uh...no biggie, press on." And on the bomb run, if you didn't know better, (by looking outside) you would have sworn you were on a normal RBS back in the states. The guys were cool personified as they commented; (Looking at the radar scope)"Yeah, there's the target. ..there's the offsets..O.K., no sweat" I guess it just goes to show you that you can adjust pretty quickly to any situations if you've had the training and experience.

But the strain sometimes manifested itself in spite of what a guy showed outwardly. My navigator, had been in headquarters, and had not been on a crew for about six years until he came to southeast Asia. He had been on my crew for about five months, and it was apparent that he had not lost any of his expertise, because he did an outstanding job as lead navigator. As we came off the target that night, he called; "Pilot, left turn, two six zero." Well, 260 degrees was to the right, of course. So, to jab him in the butt a little bit, (We were the same rank, and were often ribbing each other about our respective jobs.) I said; "You mean RIGHT TURN don't you Nav?"..."No, DAMMIT! I said LEFT TURN!"..."Uh, Nav, You want me to make a 360 degree turn to come around to two six zero?"...pregnant silence..."Uh, well, do whatever you want to!"...Nav, you want me to give you a rock to hold in one hand?" Well, that cracked everyone up, coming as it did, just as we came off the target, with SAMs whizzing through the air all around us, and it really broke some of the tension.

As we came off the target, the sky to the northeast lit up with a tremendous flare, as a B-52 blew up in the air. We knew we were losing some, without even hearing the calls. When you eject, your beeper locator beacon on your survival radio automatically starts transmitting on the guard frequency. As I said, I had been in fighters, and had heard a few of them. But when you lose a B-52, and everyone gets out, there are six of them going simultaneously. And if you lose two or three_ in the same time period, the beeping is enough to drive you bananas! You can't shut it out, and you know you've lost a big one. Every now and then that sound will come back to me...like a song that reminds you of an event. ...I guess it'll haunt me forever.

While we were in the predetermined threat area, (a set of geographical coordinates) it was hard to keep track of all of my airplanes on the common radio frequency, since there was a lot of traffic concerning SAM launches, Mig calls, "I'm hit" calls, beepers, etc. So, based on my experience from my two previous Linebacker II missions, I came up with the following procedure: As each cell entered the threat area, they would go to a discreet frequency, which would allow the cell leader to keep track of his airplanes and to call threats that applied to them without interference. Upon leaving the threat area, they would go back to the common frequency and automatically check in with me. I asked them to keep it brief, and just give me: "As briefed, (if they had gotten

their bombs on the target) out with three". (If they had their cell intact.) If they had lost one, or had some other problem, they were to elaborate. Well, they started checking in, and you could just feel everyone holding their breath as the reports came in. When the last cell checked in "as briefed, out with three", and we knew that we had gotten all the bombs on the target without losing anyone, I exclaimed; "SHIT HOT! Let's take em' home!" That really broke the tension, and you could hear all kinds of chatter up and down the radio net. After a few seconds, I asked them to cool it and we set power and climbed for our recovery altitude of 41,000, heading back to Andersen.

I was exhausted, and I gave the airplane to the co-pilot, settled back in the seat, and went to sleep. He woke me about three hours later, as we flew into the sunrise. We were pretty far back in the stream, due to our post-target position, and as far as we could see, over the horizon, there were sets of three contrails, crisscrossing as the cell navigators made their minute corrections. It was an impressive sight, and once again brought home to me the power of that raid."

The last Linebacker II sorties were flown on December 29, 1972. In the brief time that the campaign had lasted, the B-52's had dropped more than 49,000 bombs

on the enemy homeland. They had destroyed or damaged over 1600 military structures and 373 pieces of railroad equipment. An estimated three million gallons of petroleum products were destroyed. The rail system was interdicted in at least 500 places, and imports from Russia and China were reduced from 160,000 tons to 30,000 tons per month. Additionally, enemy airfields were interdicted in at least ten separate places. No B-52's were lost to Migs, and B-52 gunners were credited with two confirmed Mig kills. Fifteen B-52's were lost during Linebacker II, (an overall loss rate of 2%) and 8 crewmembers lost their lives. 25 crewmembers are still carried as missing in action. Thirty three were captured and subsequently released.

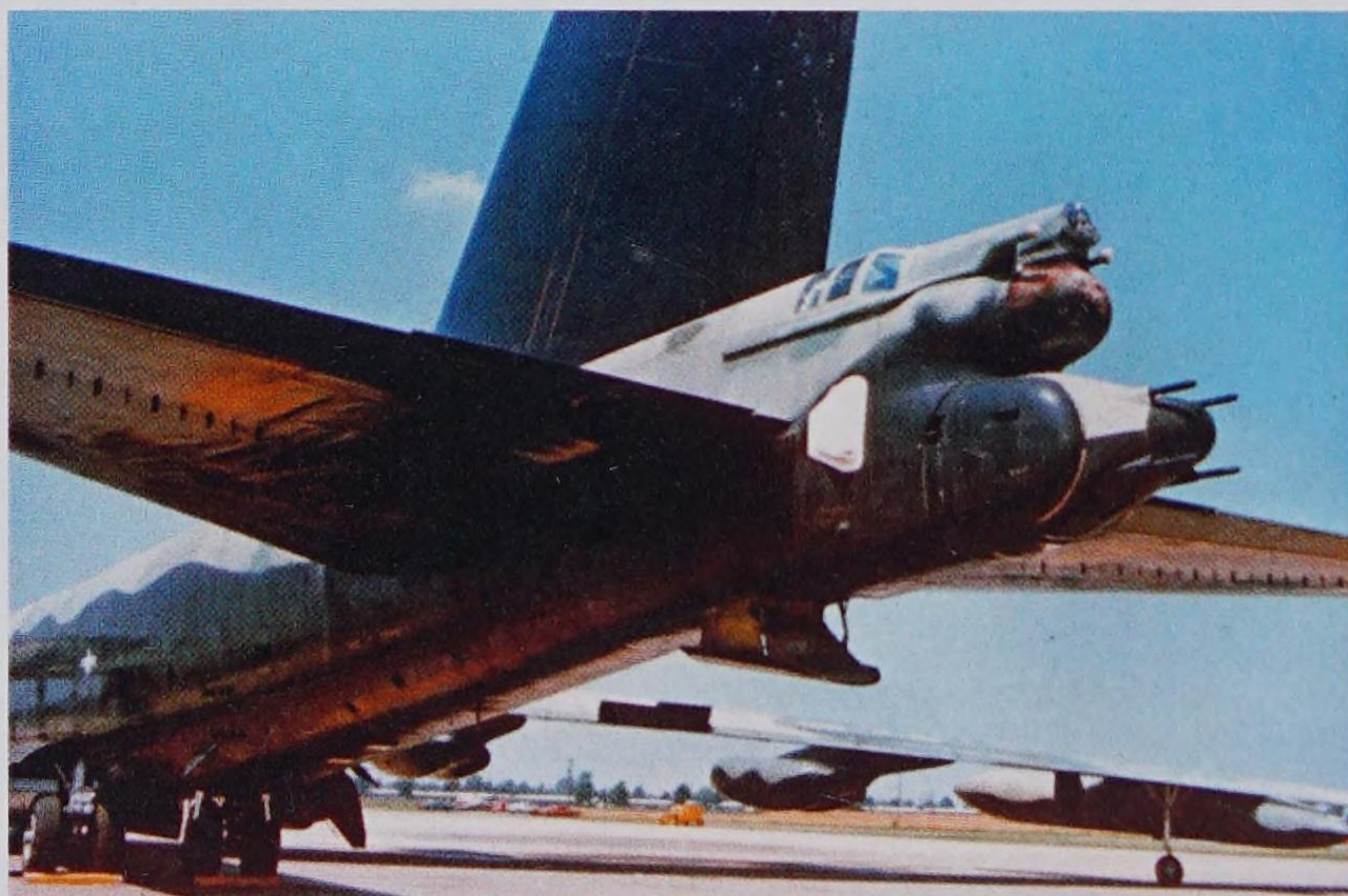
The raids had taken their toll of the enemy defenses. In the last two raids, no B-52's were hit, and it was apparent that they were bombing the enemy homeland with virtual impunity at the end of the campaign. Secretary of State Henry Kissinger stopped short of categorically crediting Linebacker II with ending U.S. participation in the war, but not by much. In his words; *"There was a deadlock which was described in the middle of December, and there was a rapid movement when negotiations resumed on the technical level on January 3rd, and on the substantive level on January 8th. These facts have to be analyzed by each person for himself".*

B-52G on Andersen AFB during Linebacker II. 68 SA-2 missiles were launched against B-52s on the first night of Linebacker II, resulting in the loss of 3 BUFFs, including 2 B-52Gs from Andersen. (USAF)

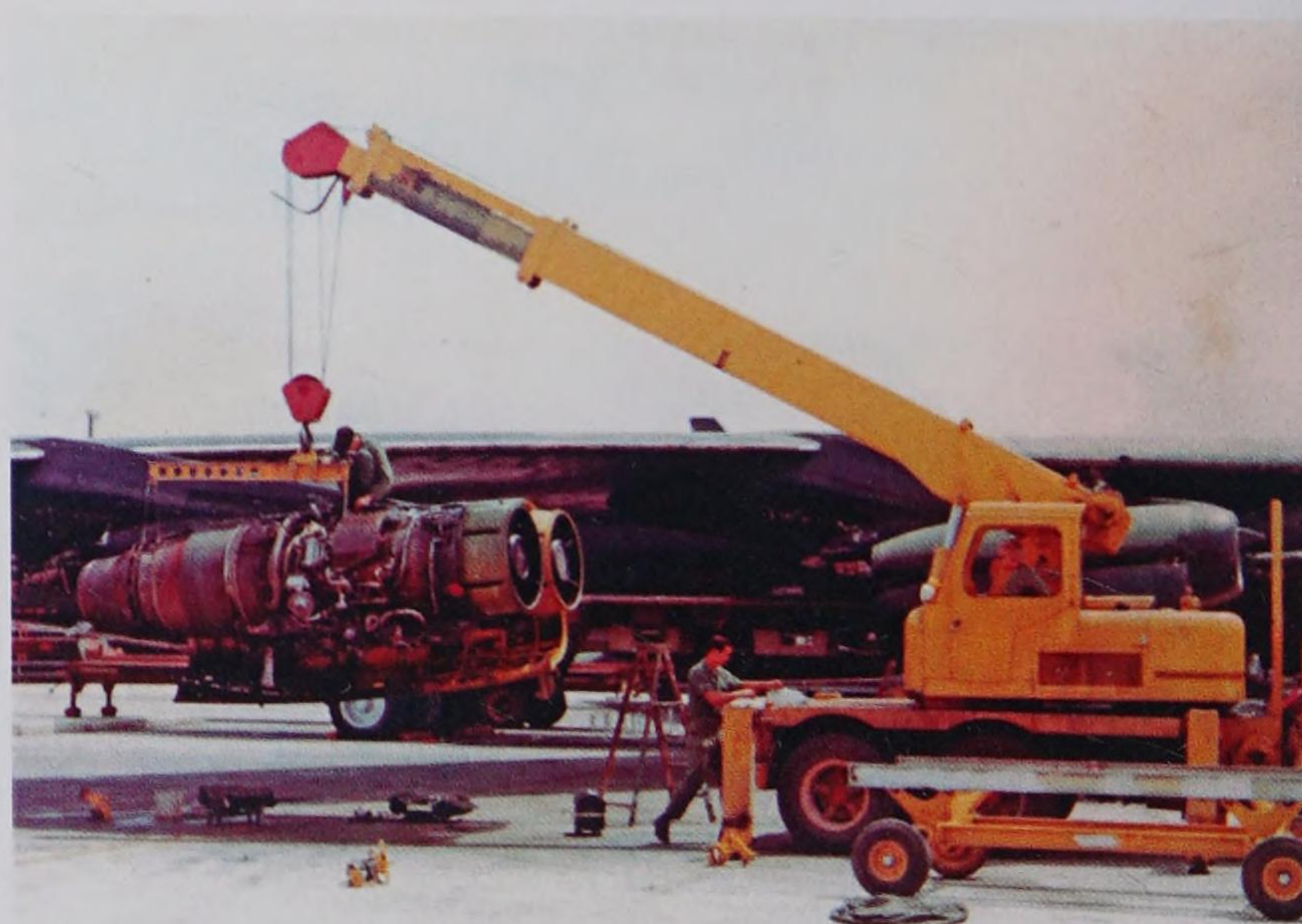




My painting depicting a B-52G over downtown Hanoi during Linebacker II, aka: "The Twelve Days of Christmas" in 1972. The North Vietnamese fired salvos of SAMs at the Buffs, ultimately knocking down 12 of the bombers, but failing to stop the destruction of vital infrastructure. These raids culminated in the adoption of peace accords.



Tailgunner A1C Albert Moore shot down a MiG-21 on Christmas Eve. (USAF)



Engine change during the height of combat operations during Linebacker II.)USAF)





It became a tradition for the B-52 mothership to make a low pass over the landing site after successful flights of the aircraft it carried aloft. (NASA)

NASA B-52s

B-52B

The NB-52B launch aircraft was operated by the NASA Dryden Flight Research Center. During its long and storied career, it participated in some of the most significant projects in aerospace history. At retirement in December 2004, the air launch and research aircraft held the distinction of being NASA's oldest aircraft, as well as being the oldest B-52 on flying status. With all that history, it had the lowest number of flying hours (2443.8) of any B-52 in operation, having been used exclusively in the role it continued to perform so reliably for nearly 50 years. The NB-52B, (AF 52-0008 NASA tail number 008), rolled out of Boeing's Seattle plant as an RB-52B, making its first flight on 11 June 1955. It was the 10th B-52 to come off the Boeing assembly line and was a U.S. Air Force test aircraft before it was assigned to support the X-15 research aircraft program at Dryden.

Missions

X-15 Program

NASA 008 was one of two B-52s used as "motherships" to air launch the three rocket-powered X-15 aircraft for research flights. Aircraft 008 was the launch aircraft on 140 of the X-15 flights and flew a total of 159 captive-carry and launch missions in the X-15 program. The X-15 was flown over a period of nearly 10 years, from June 1959 to October 1968, setting world speed and altitude records of Mach 6.7 and 354,200 feet in a program that investigated all aspects



The X-15 under the pylon from which it will be launched.

of manned hypersonic flight. The X-15 pilots were awarded astronaut wings. Those records stood for almost 40 years. Information gained from the highly successful X-15 program contributed to development of the Mercury, Gemini, Apollo, and Space Shuttle manned space flight programs.

The other B-52 used in the X-15 program, tail number 003, was retired in 1969 and is on permanent display at the Pima County Air Museum in Tucson, AZ.

The Lifting Bodies

As the Space Shuttle design evolved, designers realized that a reusable vehicle would have to be designed aerodynamically to withstand the stresses of re-entry into the atmosphere. They theorized that a wingless lifting body might be the answer. Between 1966 and 1975, B-52 008 was the



The NB-52A, with X-15 aboard, takes off for an early X-15 test flight. (NASA)

launch aircraft for 127 of the 144 flights of wingless lifting body aircraft. Lifting bodies obtain aerodynamic lift from the shape of their bodies. The addition of fins and control surfaces allowed research pilots to stabilize and control the vehicles and maintain a predetermined flight path. Research flights with the vehicles proved that vehicles entering the atmosphere from space could be maneuvered to a safe runway landing — paving the way for full development of the space shuttle.

Space Shuttle Program Support

In 1977 and 1978, and again in the 1983-1985 time period, 008 was used as the launch aircraft in the test and development of the parachute recovery system used to recover the Space Shuttle's solid rocket boosters. From July to October of 1990, the veteran B-52B was used for a series of eight tests of a drag chute deployment system being installed on Space Shuttle orbiters. Given their very high landing speeds, the drag chutes are a critical necessity for orbiters to land shorter distances and to reduce tire and brake wear. The test unit, consisting of the test drag chute and its attachment and deployment systems, was installed in the tail of NASA 008, along with instrumentation to record loads and pressures on the deployed parachute and also on the structure of the aircraft. Tests were carried out at landing speeds ranging from 160 to 230 mph on a lakebed runway and also on the main concrete runway at Edwards. They demonstrated the initiation, deployment, inflation, and overall operation of the orbiter drag chute system. Data from the tests were used to validate predicted loads. The first operational use of the drag chute system was on Shuttle Endeavour during its first landing on 16 May 1992.

Miscellaneous Support

NASA 008 was the launch aircraft for several remotely piloted aircraft flown by Dryden in the 1970s and



X-15 pilots constituted the pinnacle of the mythical ziggurat of "The Right Stuff". The X-15 flight crew, left to right: Air Force Captain Joseph H. Engle, Air Force Major Robert A. Rushworth, NASA pilot John B. "Jack" McKay, Air Force pilot William J. "Pete" Knight, NASA pilot Milton O. Thompson, and NASA pilot Bill Dana. Of their 125 X-15 flights, 8 were above the 50 miles that constituted the Air Force's definition of the beginning of space (Engle 3, Dana 2, Rushworth, Knight, and McKay one each).

1980s to study spin-stall, high angle of attack, and maneuvering characteristics. They were the sub-scale F-15 spin research vehicle; the Highly Maneuverable Aircraft Technology, or HiMAT research aircraft; and the Drones for Aerodynamic and Structural Testing, or DAST project, which investigated aerodynamic loads alleviation.

The first of four lengthy series of test flights began in 1979 for a U. S. Air Force project to certify an extension of the operational life of the parachute recovery system on the F-111 crew escape module. The tests concluded in 1992. The tests, using 008 as the airdrop vehicle for the parachute test articles, were part of a continuing Air Force program to improve the recovery system's capability.



Neil Armstrong, the first man to walk on the moon, was also an X-15 test pilot, winning his Astronaut Wings before joining the Gemini Program in the second group of Astronauts. (NASA)

NASA 008 was used as the air launch platform for the first six commercially developed Pegasus rocket boosters. The three-stage Pegasus is designed to put a payload into earth orbit after being launched horizontally from a carrier aircraft's wing. Pegasus was developed by Orbital Sciences Corporation under sponsorship of the Defense Advanced Research Projects Agency (DARPA) as part of the agency's Advanced Space Technology Program. The first Pegasus launch from NASA 008 was on April 5, 1990, over the Pacific Ocean, about 60 miles southwest of Monterey, CA.

NASA 008's primary mission for several years was as the launch platform for the X-38 Crew Return Vehicle.

The maiden free-flight of the X-38 prototype space station lifeboat occurred in March 1998. Mission support continued until the X-38 project was canceled in 2001.

Hyper-X

In its final role NASA 008 served as the launch aircraft for NASA's Hyper-X project. The project's primary purpose was to explore an alternative to rocket power for space access vehicles. The Hyper-X project consisted of three unmanned 12-foot long, hypersonic scramjet-powered X-43A research vehicles. The first X-43A vehicle was lost on June 2, 2001, following termination of the flight after the Pegasus-derived booster rocket deviated from the planned trajectory. The second X-43A launch proved the concept of hypersonic scramjet-powered flight. On March 27, 2004, NASA 008 carried the X-43A, mounted on a modified Pegasus booster rocket, up to the drop altitude of 40,000 feet. The rocket boosted the X-43A up to its test altitude of about 95,000 feet over the Pacific Ocean, where the X-43A separated from the booster and flew freely at its test speed of Mach 6.8. This was the first time an air-breathing scramjet powered aircraft had flown freely. In the process, it set a new world speed record for flight powered by an air-breathing engine. The third and final X-43A also flew successfully on 16 November 2004, following launch from NASA 008 on its final research mission. This X-43A, also launched from 40,000 feet, was boosted to a test altitude of 110,000 feet and a speed of about Mach 9.6.

NASA 008's first and last missions launched hypersonic research vehicles, from the X-15 in 1960 to the X-43 in 2004.



The NB-52A, Air Force serial 52-0003, was named "The High and Mighty One".



NASA 008 was formally retired on Dec. 17, 2004 in a joint NASA and U.S. Air Force ceremony and returned to the Air Force. It is now on permanent public display near the north gate of Edwards Air Force Base.

All those NASA missions required major structural modifications to the B-52B, including the cutout of a large notch in the aircraft's right inboard wing flap to accommodate the vertical tail on the three X-15 aircraft. This notch also served the Pegasus and Hyper-X projects. Additional mods included installation of various pylons used to carry research vehicles and test articles to be air dropped occurred over the years. The pylons were attached under the right wing between the inboard engine pod and fuselage. Each pylon was subjected to extensive drag, airflow and loads testing before use. The pylon used to attach the X-43A and its booster to the B-52B is the same pylon used for the X-15 program. Special instrumentation was installed aboard NASA 008 to record and transmit test and research data and video to the Dryden Mission Control Room or other receivers during research missions. A second Launch Panel Operator position was added

to augment the existing one for the Hyper-X project.

B-52H

The NB-52B had performed admirably over the years, but as retirement loomed, NASA thought they would need a replacement, so in 2001 NASA obtained a B-52H. NASA Dryden's fabrication branch built a new, in-house designed pylon for the B-52H to carry aerospace test vehicles aloft. The new pylon was designed with the flexibility to adapt to the variety of aerospace vehicle shapes and sizes, and could carry a load weighing up to 25,000 lb.

The B-52H, USAF serial number 61-0025, arrived at NASA Dryden on July 30, 2001 from the USAF's 23rd Bomb Squadron, 5th Bombardment Wing, located at Minot AFB, ND. Initially placed on loan, the aircraft was later transferred from the USAF to NASA.

NASA was performing design, analysis, and testing leading up to a Critical Design Review at the end of 2007. As



Balls 8 (the name was derived from the serial number, 52-0008) was originally an RB-52B. It was first flown on June 11, 1955, and entered service with NASA on June 8, 1959. It was modified at North American Aviation's Palmdale facility to enable it to carry the X-15. Balls 8 flew 159 captive-carry and launch missions for the X-15 program from June 1959 until October 1968. It was first used to launch the X-15 on its fifth flight, January 23, 1960. It also flew missions for the X-24, HiMAT, Lifting Body vehicles, X-43, early launches of the OSC Pegasus rocket and numerous other programs. At its retirement on 17 December 2004, Balls 8 was the oldest active B-52 in service, and the only active B-52 not of the H model. It also had the lowest total airframe time of any operational B-52. It is on permanent public display near the north gate of Edwards Air Force Base in California. On the preceding page, The X-15A-2, modified from the number two aircraft and delivered to NASA in February 1964, added a 28-in. fuselage extension to carry liquid hydrogen for a supersonic combustion ramjet that was flown (as a dummy) but never tested. It also had external tanks for liquid ammonia and liquid oxygen. These tanks provided roughly 60 seconds of additional engine burn and were used on the aircraft's Mach 6.7 flight. While adding to the speed the X-15 did achieve, the tanks also increased the aircraft's weight to almost 57,000 lb and added significantly to the drag experienced by the aircraft in flight. A white ablative coating was added to the aircraft for the highest speed flights. (NASA)



The NB-52 takes off with the X-43A. The X-43 was an unmanned experimental hypersonic aircraft with multiple planned scale variations meant to test various aspects of hypersonic flight. It was part of the X-plane series and a component of NASA's Hyper-X program. It set several airspeed records for jetpropelled aircraft. The X-43 is the fastest aircraft on record at approximately 7,000 miles per hour. (NASA)



Bill Dana flew the HL-10 to 90,030 feet, which became the highest altitude reached in the program. Seen here after exiting the vehicle, post-landing, while the NB-52 does a fly-over. The HL-10 was built by the Northrop Corporation as a “heavy” lifting body. “HL” stands for horizontal landing, and “10” refers to the tenth design studied by engineers at NASA’s Langley Research Center, Hampton, VA. The lifting body program was initiated to validate designs for what eventually became the Space Shuttle. (NASA)

part of the preliminary studies, several “captive-carry” flights were planned to be flown by the F-15 with an inactive missile with no propellant carried on the aircraft’s centerline pylon to determine the performance of the aircraft when carrying the missile. The project has not been funded to conduct actual launches to obtain hypersonic flight test data, and a decision on funding such research was not expected before 2008. Following de-militarization and programmed depot maintenance at Tinker Air Force Base, OK, a flight research instrumentation package was then installed on the aircraft, as well as other modifications to support its launch platform role. The B-52H was intended to replace Dryden’s famous B-52B “008”, which was retired on Dec. 17, 2004. However, with no research projects requiring its capabilities on the horizon under NASA’s restructured aeronautics research programs, the decision was made to return the aircraft to the Air Force.



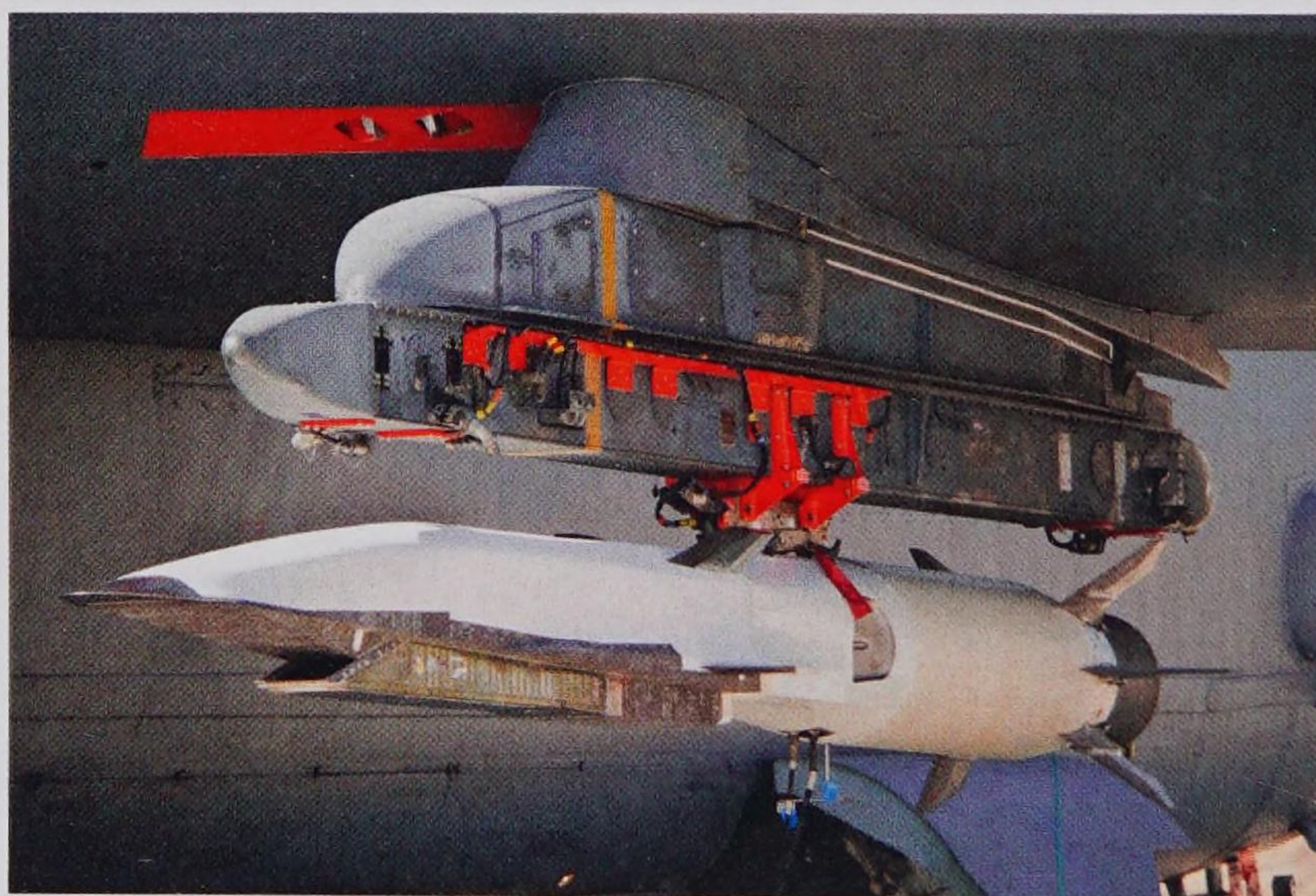
The X-38 project was a series of five prototype research vehicles developing technology to build and operate a space station crew return vehicle (CRV). The wingless CRV, when operational, would be the first reusable human spacecraft to be built in more than two decades. It was meant to provide a crew return vehicle from the International Space Station. The program was eventually cancelled. (NASA)



The launch pylon received several modifications over its life to accommodate the wide range of vehicles dropped from the B-52. (NASA)



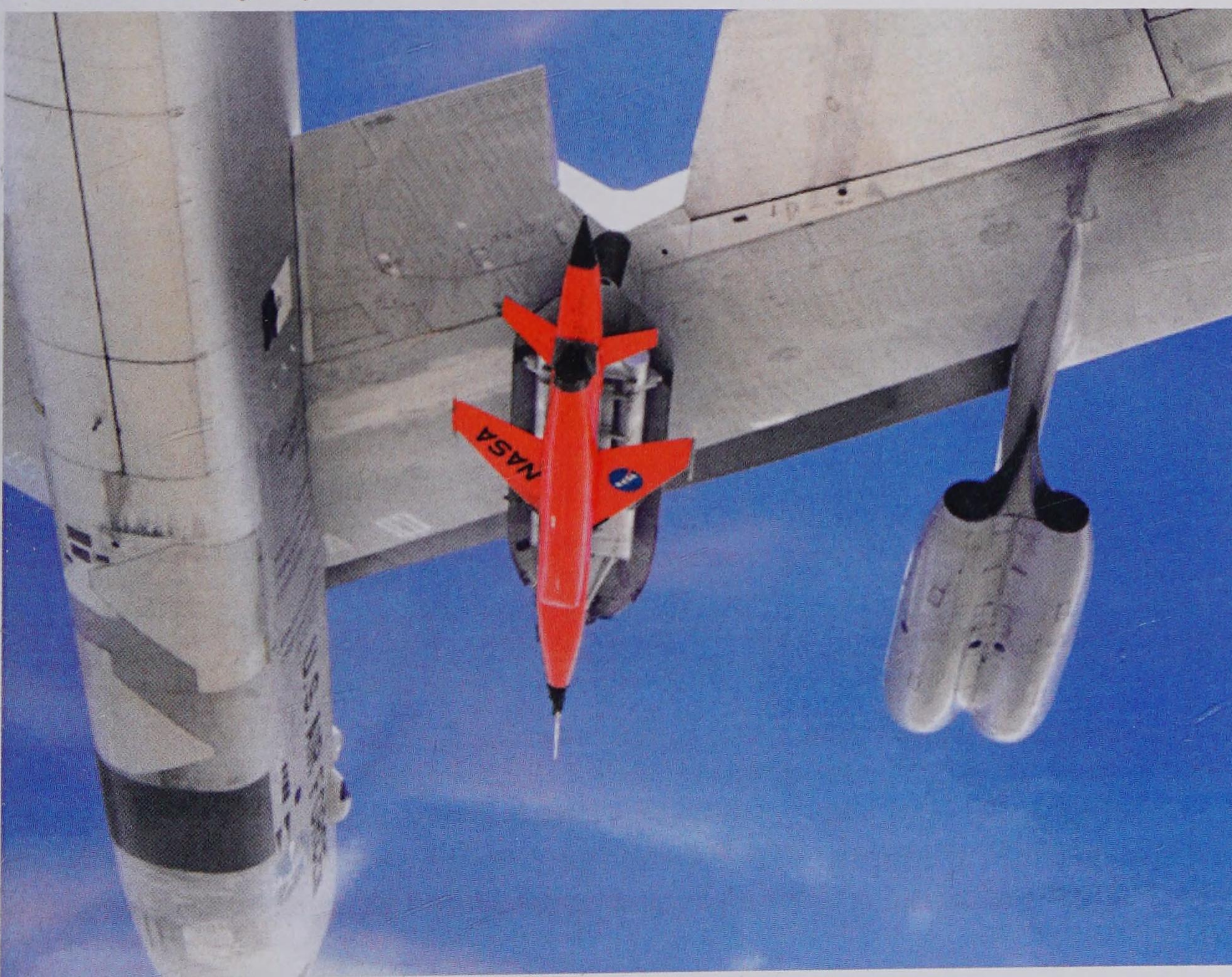
A new era in space flight began in April 1990 when NASA launched the first Pegasus rocket from a NASA B-52 aircraft out of Dryden Flight Research Center in California. (NASA)



The Boeing X-51 WaveRider) mounted on a B-52 at Edwards AFB. Waverider is an unmanned scramjet demonstration aircraft for hypersonic (Mach 6, approximately 4,000 miles per hour) flight testing. It completed its first powered hypersonic flight on 26 May 2010. After two unsuccessful test flights, the X-51 completed a flight of over six minutes and reached speeds of over Mach 5 for 210 seconds on 1 May 2013 for the longest duration hypersonic flight. The X-51 received the name "WaveRider" because it uses its shock waves to add compression lift. The program was a cooperative effort of the United States Air Force, DARPA, NASA, Boeing, and Pratt & Whitney Rocketdyne. The program was managed by the Aerospace Systems Directorate within the U.S. Air Force Research Laboratory (AFRL). X-51 technology will be used in the High Speed Strike Weapon (HSSW), a Mach 5+ missile planned to enter service in the mid- 2020s. (USAF)



The Control Configured Vehicle (CCV) Program was an outgrowth of the Load Alleviation and Mode Stabilization (LAMS) Program. Additional control surfaces were installed on this NB-52E in an attempt to mitigate gust loads on the flexible airframe of the B-52. The SB-52E LAMS aircraft, B-52E-85-BO 56-0632, was modified for the CCV program in 1971, three years after the conclusion of the LAMS program. The program was completed in 1974. The term CCV is used to describe a design philosophy in which modern control technology is allowed to impact vehicle design from early in its design cycle. The configuration changes made to the B-52 included two sets of canards added to the nose of the aircraft, one horizontal set on the side of the fuselage, with the other mounted at about a 45 degree angle under and slightly forward of the horizontal pair. Also added were out-board ailerons and inboard flaperons along with a 2000-pound ballast carried in each of the outboard tip tanks. LAMS modifications included the addition of hydraulically powered controls, a fly-by-wire (FBW) pilot station, associated electronics and analog computers at the test engineer's stations, instrumentation for system evaluation, and the LAMS flight controller.



From 1977 to 1983, the Dryden Flight Research Center, Edwards, California, (under two different names) conducted the DAST Program as a high-risk flight experiment using a ground-controlled, specially modified Teledyne-Ryan BQM-34E/F Firebee II supersonic target drone that was flown to validate theoretical predictions under actual flight conditions in a joint project with the Langley Research Center, Hampton, Virginia. (NASA)



The NB-52B was first used to launch an X-15 on Jan. 23, 1960, the fifth X-15 flight. It served as launch aircraft for 106 of the 199 X-15 research missions and several captive flights. It was also used as mothership for the lifting bodies (HL10, M2-F2, M2-F3, X-24A, X-24B); F-15 Spin Research Vehicle; Highly Maneuverable Aircraft Technology, or HiMAT remotely piloted research vehicle; drones for aerodynamic and structural testing; as a space shuttle solid rocket booster parachute system drop test vehicle; F-111 crew escape capsule recovery system parachute test vehicle; Pegasus expendable launch vehicle; X-38 Crew Return Vehicle technology demonstrator; and X-43A hypersonic research vehicle. It was used in numerous other programs, including Inertial Flight Data System pod tests; space shuttle drag chute tests; supersonic cruise emissions environmental studies; F-16 radar target studies; Air Force strategic studies of laser propagation through aircraft wake vortices; and tests of a prototype interphone system. The airplane's fuselage was decorated with mission markings denoting its history and accomplishments. The NB-52B made a total of 1,051 flights and logged 2,443.8 flight hours. It was retired by NASA and returned to the Air Force on Dec. 17, 2004.

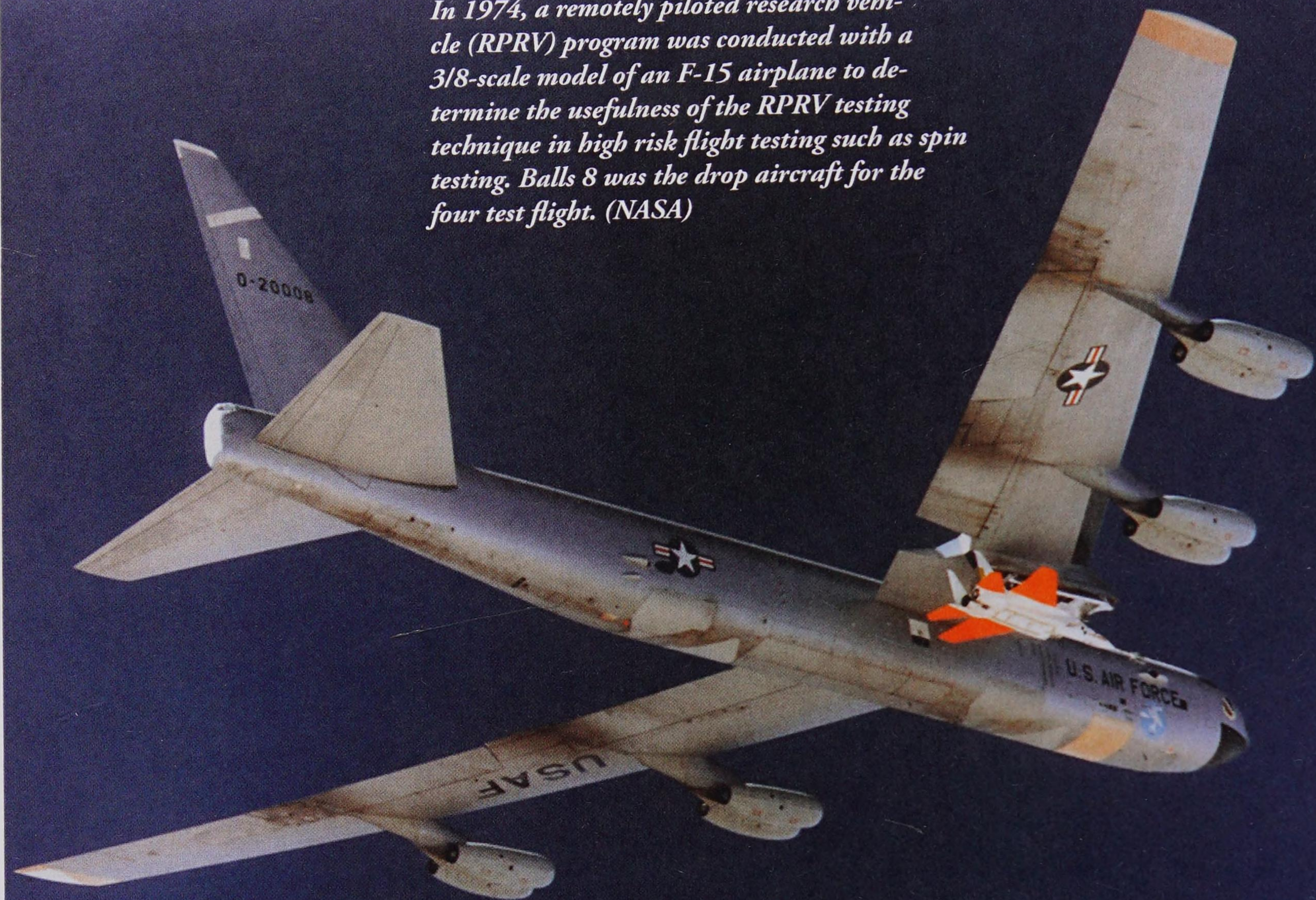


The NASA X-43A hypersonic research vehicle and its Pegasus booster rocket, mounted beneath the wing of their B-52 mothership, had a successful first captive-carry flight on 28 April 2001. It was a dress rehearsal for a subsequent free flight, the captive-carry flight kept the X-43A-and-Pegasus combination attached to the B-52's wing pylon throughout the almost two hour mission from NASA's Dryden Flight Research Center. The NASA X- 43A hypersonic research vehicle and its Pegasusbooster rocket, mounted beneath the wing of their B-52 mothership, had a successful first captivecarry flight on April 28, 2001. Basically a dress rehearsal for a subsequent free flight, the captive-carry flight kept the X-43A and Pegasus combination attached to the B-52's wing pylon throughout the almost two-hour mission from NASA's Dryden Flight Research Center, Edwards AFB.



The NB-52E was used as a flying test bed for the TF-39 engine that powered the C-5A. The TF-39 was a revolutionary engine for its time. It develops a thrust of 43,000 pounds, while improving fuel efficiency by about 25%. The test program ran during 1964. The success of these tests has ultimately resulted in renewed interest in re-engining the B-52, but the austerity of reconciliation has halted many military programs, and as this is written, there is no plan going forward for a re-engining of the Buff.

In 1974, a remotely piloted research vehicle (RPRV) program was conducted with a 3/8-scale model of an F-15 airplane to determine the usefulness of the RPRV testing technique in high risk flight testing such as spin testing. Balls 8 was the drop aircraft for the four test flight. (NASA)



Balls Eight used a bomb-bay drop to test the recovery parachute system for the F-111 crew escape capsule. (NASA)



Balls 8 turns onto the final bearing before release of the X-38 on November 2, 2000. The X-38 prototypes were intended to perfect a "crew lifeboat" for the International Space Station. The X-38 vehicle 131R demonstrated a huge 7,500 square-foot parafoil that would have enabled the Crew Return Vehicle (CRV) to land on the length of a football field after returning from space. The CRV was intended to serve as an emergency transport to carry a crew to safety in the event of problems with the International Space Station. (NASA Photo / Jim Ross)





Balls 8 over the Dryden Research Center at Edwards AFB after the successful launch of the 2nd X-43A Hypersonic Research Vehicle on 27 March 2004. (NASA)



An experimental space shuttle drag chute deploys in a cloud of dust behind NASA's NB-52B research aircraft just after landing on Rogers Dry Lake at Edwards Air Force Base, Calif., on Aug. 2, 1990. The tests helped validate the effectiveness of the chute in reducing the rollout distance and brake wear during shuttle landings. The Shuttle drag chute reduced landing roll by about 2,000 feet. (NASA photo)



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(above) The retirement of Balls 8 brought out those pilots who flew the airplane. Seated from left, Dryden Center Director Kevin Petersen, Air Force Flight Test Center Commander Brig. Gen. Curtis Bedke, former Dryden pilot Fitzhugh L. "Fitz" Fulton Jr., Dryden Chief Pilot Gordon Fullerton, and AFFTC Historian James Young. Former Dryden pilot Ed Schneider hosted the retirement ceremony of Balls 8 on 17 December 2004.

"This airplane has played a pivotal yet largely unsung role in many significant aeronautics and space flight programs," Schneider told a large crowd gathered in Dryden's 4802 hangar. "I was privileged to fly her and perform some of the many tests represented by the silhouettes on her fuselage - 008 is a grand lady and always fun to fly."

Schneider was one of the most famous test pilots of NASA. During his 18-year career at Dryden, Schneider was best known for his work as project pilot for the F-18 High Alpha Research Vehicle (HARV) over a nine-year span, becoming the first pilot in history to conduct multi-axis thrust vectored flight. Schneider also served as project pilot for the F-18 Systems Research Aircraft, the F-8 Digital Fly-By-Wire research program, the Boeing 720 Controlled Impact Demonstration, the F-14 Automatic Rudder Interconnect and Laminar Flow research programs, the F-104 Aeronautical Research and Microgravity programs, the F-15 ACTIVE, the SR-71 High Speed research project, the NASA B-52B launch aircraft, and the F-15B aeronautical testbed aircraft. Schneider transferred from Dryden to NASA's Johnson Space Center, Houston, in September 2000 where he was a staff pilot and T-38 instructor pilot. When he left Dryden, he had accumulated more than 6,700 flight hours in 84 different models of aircraft and had flown "first flights" on five unique aircraft configurations. Schneider retired from NASA in 2004. Prior to joining NASA, Schneider served on active duty with the U.S. Navy from 1968 to 1983. Following squadron service, he graduated from the U.S. Naval Test Pilot School, Patuxent River, MD, in 1973, as the youngest graduate in the school's history. He then served as an engineering test pilot and test pilot school instructor at the Naval Air Test Center. He also served as the F-4 program manager, and senior test pilot at the Naval Aviation Depot, North Island, CA. (NASA Photo by Tom Tschida)

NB-52 Pilots



Fitzhugh L. Fulton

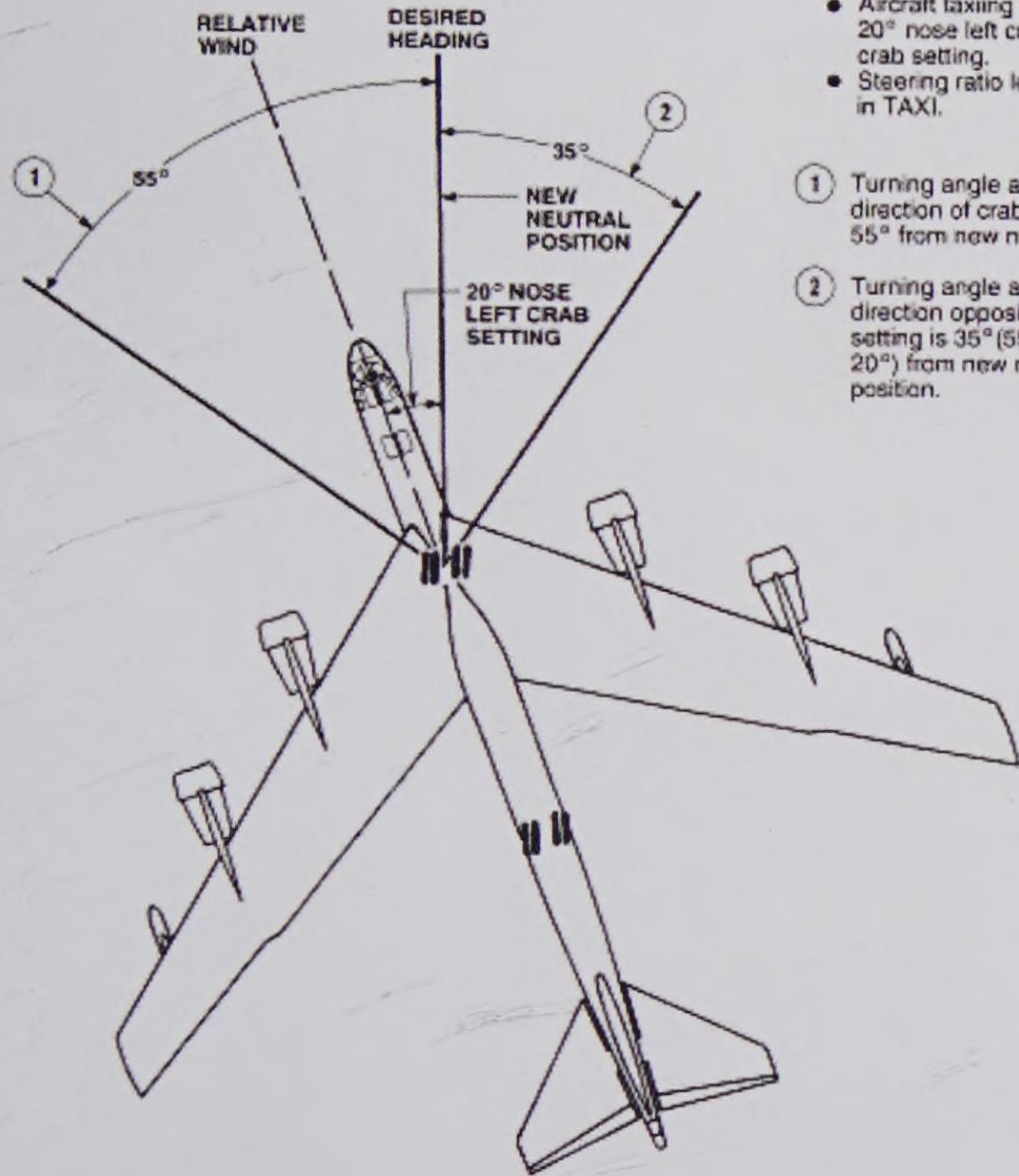
During his career at Dryden, Fulton was project pilot on NASA's B-52 launch aircraft used to air launch a variety of piloted and unmanned research aircraft, including the X-15s and lifting bodies, as well as project pilot on the Laminar Flow Control Leading Edge research program using a specially modified C-140 JetStar. He flew the XB-70 prototype supersonic bomber on both NASA-USAF tests and NASA research flights during the late 1960s, attaining speeds exceeding Mach 3. He was also a project pilot on the YF-12A and YF-12C research program from April 14, 1969, until September 25, 1978. The planes were flown at speeds and altitudes in excess of 2,000 mph and 70,000 feet to acquire flight data for the development of future aircraft.



Gordon Fullerton

With more than 16,000 hours of flying time, he has piloted 135 different types of aircraft, including full qualification in the T-33, T-34, T-37, T-38 and T-39; F-86, F-101, F-104, F-106, F-111, F-14 and F-15; X-29; KC-135; C-140 and B-47. At Dryden, he most recently flew the T-38, F-18, NB-52B, 747 Shuttle Carrier Aircraft, DC-8, Gulfstream III and T-34C. Looking back over his Dryden experiences, though, Fullerton says a few projects jump out of the logbook as having been the most memorable. Asked to point up the highlights, he starts with the projects that involved dropping various experiments from the workhorse NB-52B, known as "Balls 8" for its tail number of 008.

Turning Angles Available With Maximum Crosswind Crab Setting



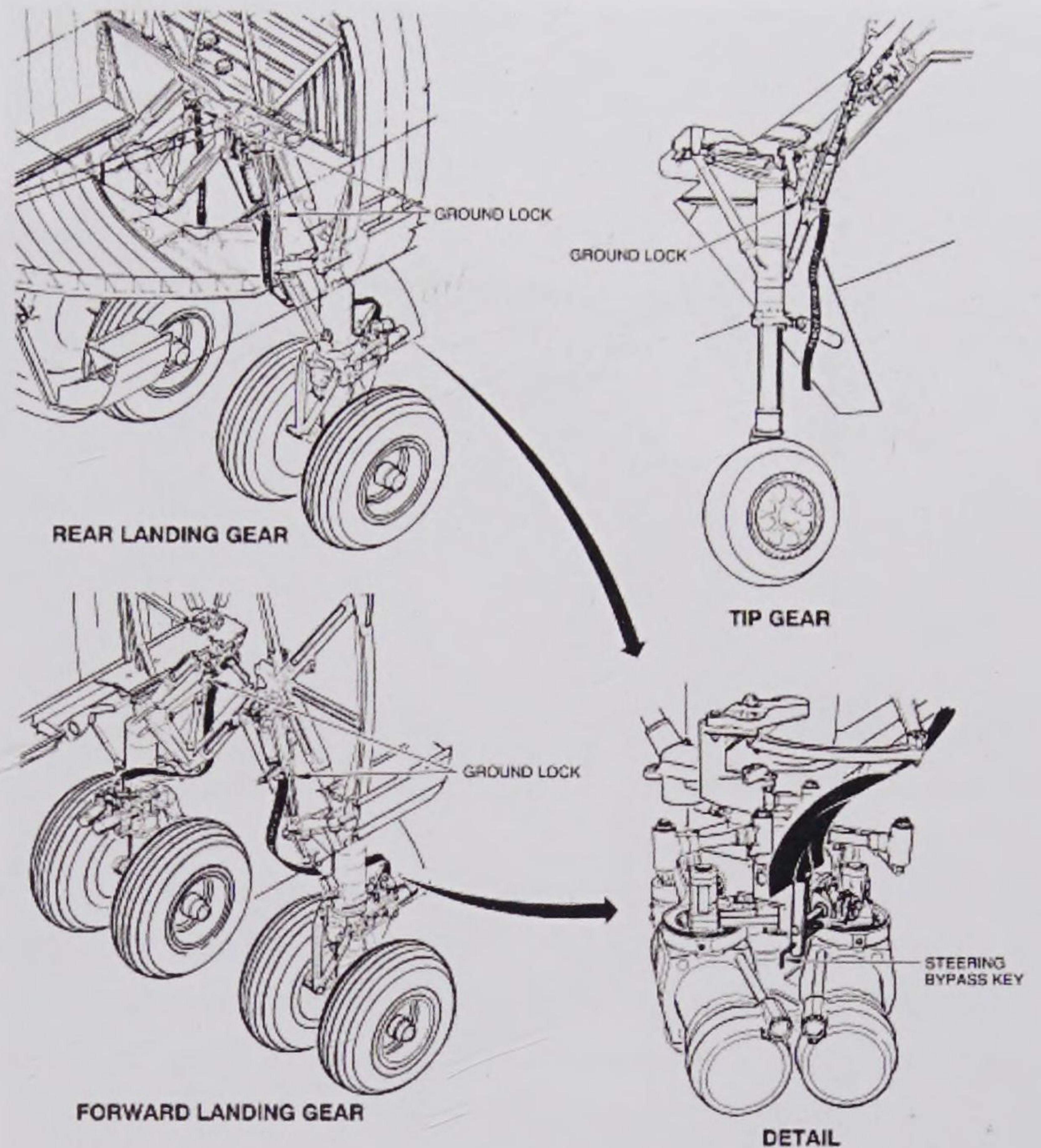
REMARKS:

Crab setting refers to direction of the nose of the aircraft relative to desired heading.

CONDITIONS:

- Aircraft taxiing with 20° nose left crosswind crab setting.
- Steering ratio lever in TAXI.

- 1 Turning angle available in direction of crab setting is 55° from new neutral position.
- 2 Turning angle available in direction opposite crab setting is 35° (55° minus 20°) from new neutral position.



(below) Airman 1st Class Eriberto Gonzalez Gomez, 5th Aircraft Maintenance Squadron crew chief, Minot Air Force Base, N.D., secures panels on a B-52 during launch procedures as part of a standoff weapons integration training exercise at Ellsworth AFB. (U.S. Air Force photo by Senior Airman Anania Tekurio)

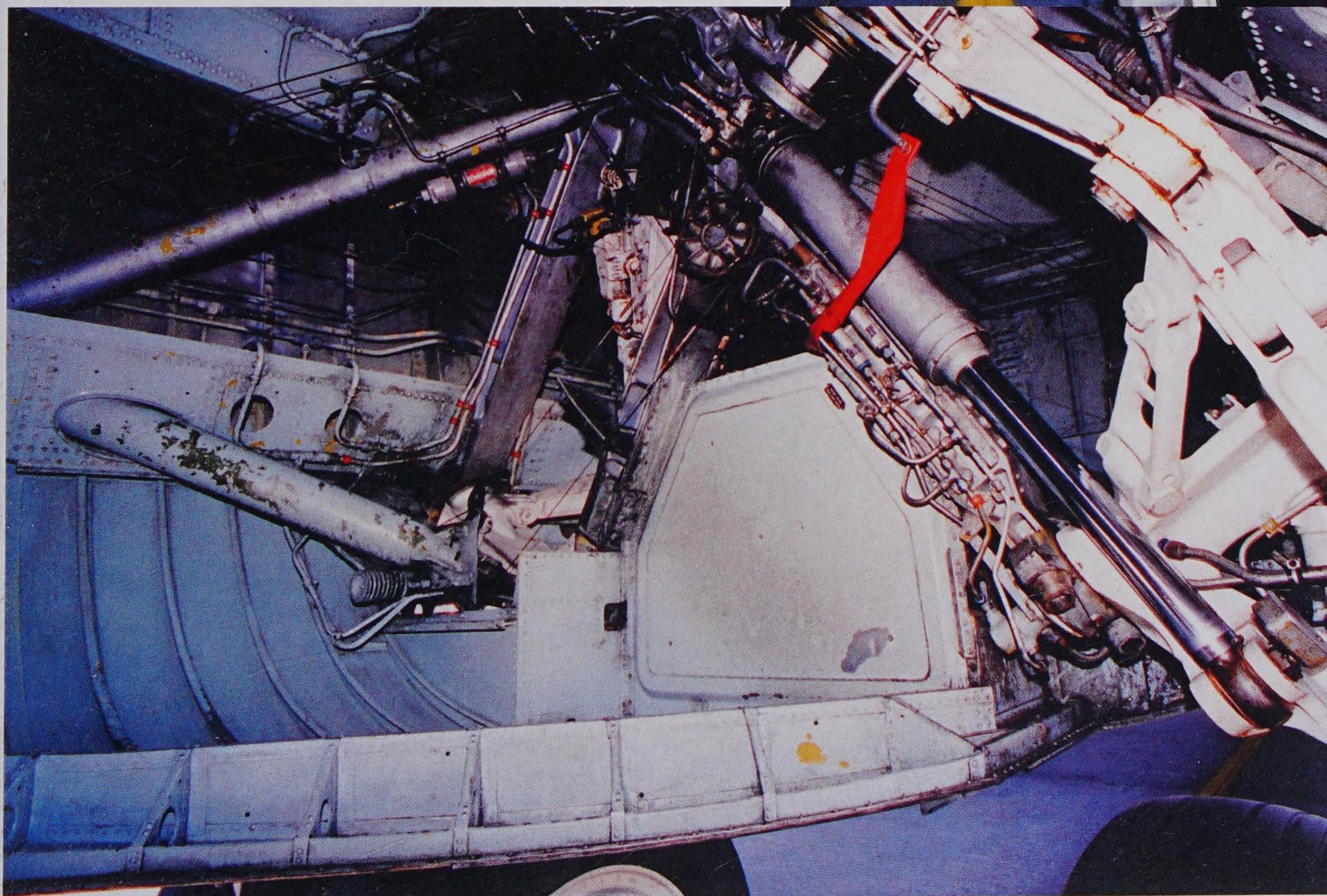
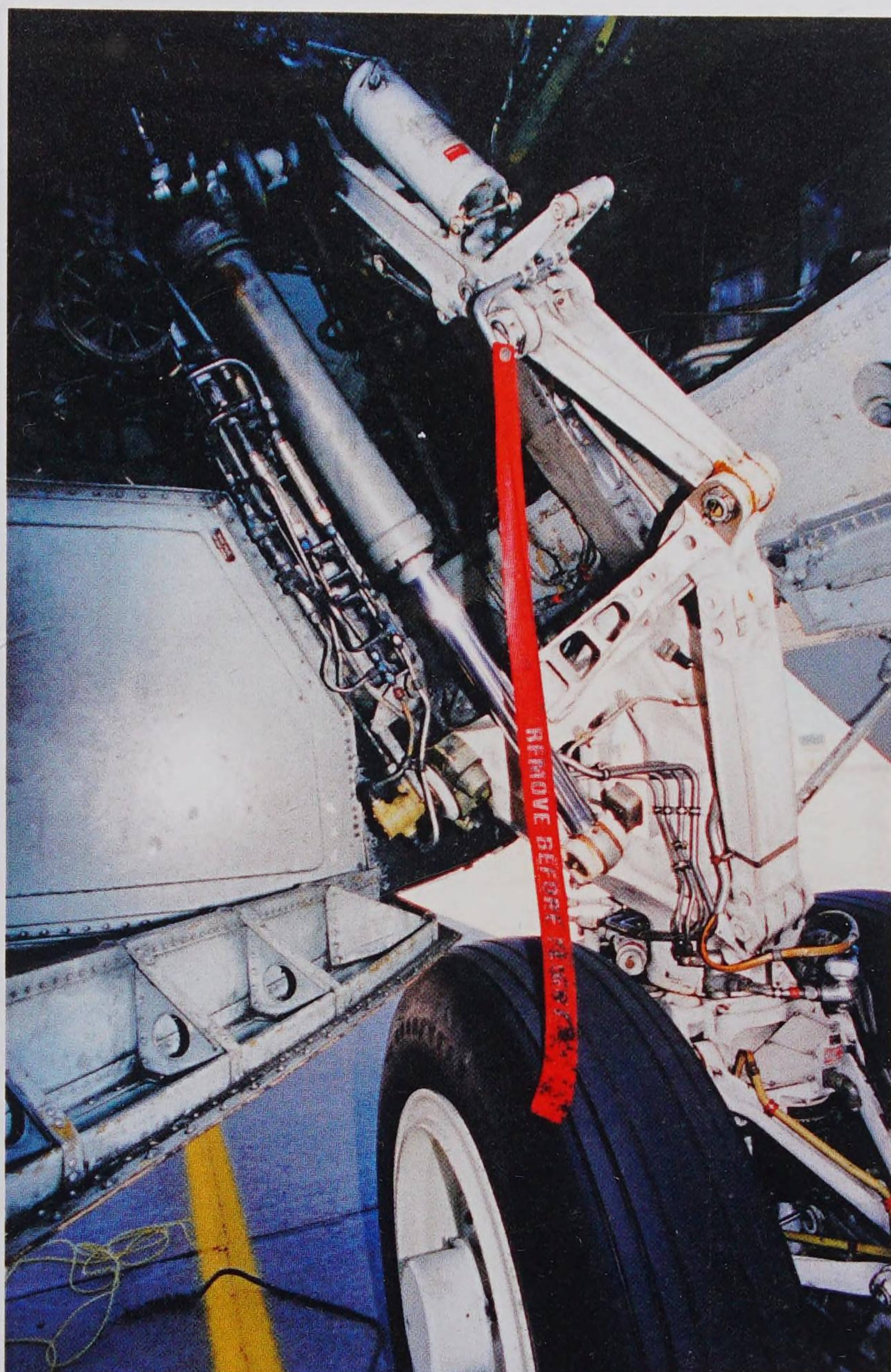




U.S. Air Force B-52 Stratofortress aircraft from Barksdale Air Force Base, La., arrived at Al Udeid Air Base, Qatar, April 9, 2016 in support of Operation Inherent Resolve, the operation to eliminate the Islamic State of Iraq and the Levant and the threat they pose to Iraq, Syria and the wider international community, and as needed in the region. The B-52 offers diverse capabilities including the delivery of precision weapons. (U.S. Air Force photo/ Tech. Sgt. Nathan Lipscomb)



(left) Staff Sgt. Randy Simmons and Senior Airmen Benjamin David, Steven Campos and Matthew Easton push a fresh B-52 Stratofortress tire toward its mount April 7 at a forward-deployed location. Two or three of the 500-pound tires get changed each day. The old tire is removed and then bled of its air. The new four-foot tall tire is then mounted in place. The whole process takes about 20 minutes for each tire. (U.S. Air Force photo by Tech. Sgt. Jason Tudor)



*Landing
Gear de-
tails.*

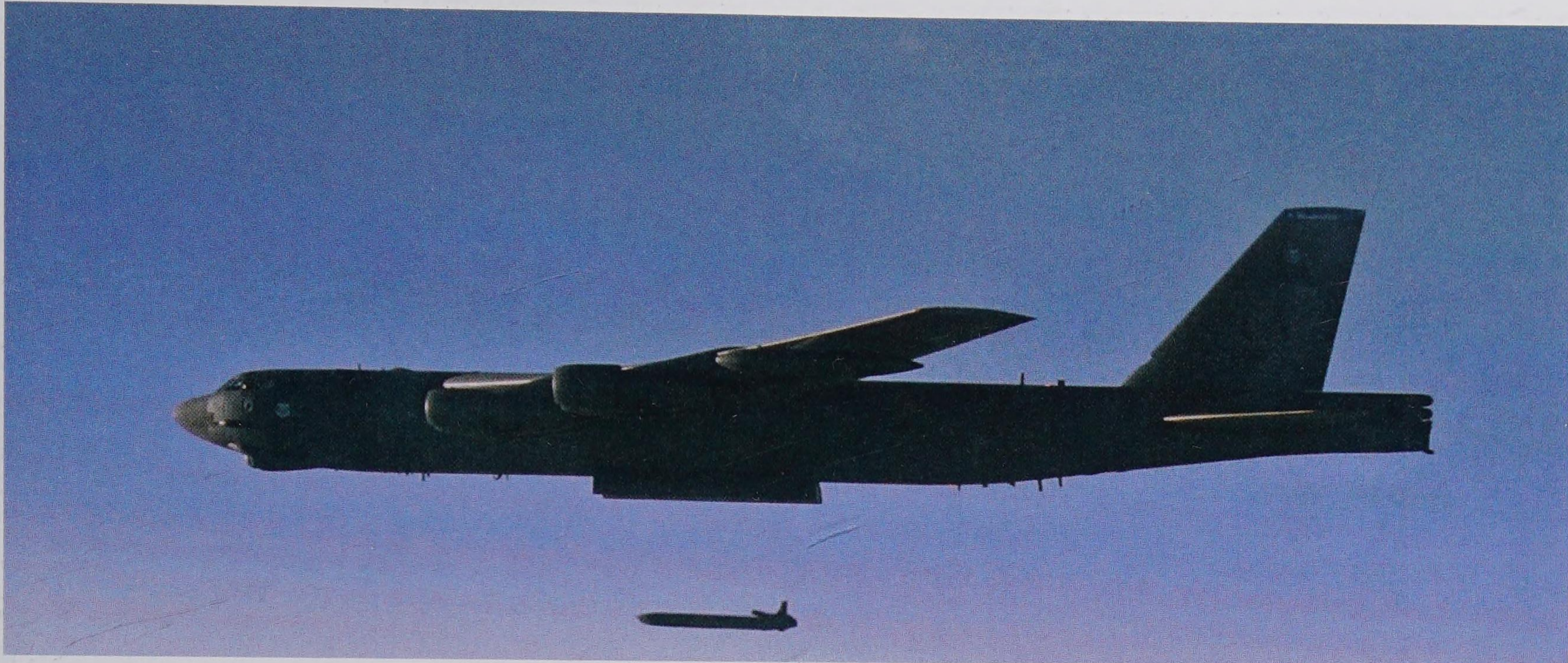


(above) Doug Shroyer, 5th Operations Support Squadron contractor and system operator, pilots the B52-H Stratofortress weapons system trainer during a simulated flight on Minot Air Force Base, N.D., Dec. 3, 2014. New capabilities for conducting missions in the weapons system trainer are now complemented by the ability to record every action taken or word said during a scenario. (U.S. Air Force photo/Senior Airman Stephanie Morris)

(left) A simulation of the Las Vegas strip is viewed from the cockpit of the B52-H Stratofortress weapons system trainer during a simulated flight on Minot Air Force Base, N.D., Dec. 3, 2014. The WST conducts two large force exercises per week in addition to virtual flag exercises that last nine days and consist of five missions. They also partner with Airborne Warning and Control Squadrons, River Joints who identify ground threats and radars and tactical air control parties. (U.S. Air Force photo/Senior Airman Stephanie Morris)



Capt. Dino Johnson, 69th Bomb Squadron weapons system officer instructor, trains 1st Lt. Wade Waldmann, 69th BS weapons systems officer, on the controls of a B-52H Stratofortress during a simulated flight in the B-52 navigator simulator at Minot Air Force Base, N.D., March 8, 2017. The navigator simulator is located next to the B-52 weapons system trainer and allows aircrews to prepare for real world flight, emergencies and combat. (U.S. Air Force photo/Airman 1st Class Alyssa M. Akers)



Unarmed AGM-86B Air-Launched Cruise Missile, or ALCM, is released from a B-52H Stratofortress over the Utah Test and Training Range during a previous Nuclear Weapons System Evaluation Program sortie on Sept. 22, 2014. Recent sorties underscored the cruise-missile capability of the B-52H and the ALCM's sustainability. (U.S. Air Force file photo/ Staff Sgt. Roidan Carlson)

Keeping the BUFF relevant.

On 12 October 2010 the U.S. Air Force announced that it would spend \$11.9 billion to keep its remaining B-52 bombers in service until they are all retired by 2040. The new "sustainment program" will cost over \$150 million per aircraft, which is about twice what they originally cost to build (accounting for inflation). This very significant investment in half century old aircraft is testament to fact that the B-52 is very capable, reliable and cheap to operate. This is especially true compared to the aircraft built to replace it (the B-1B). The mission-capable rate, which measures the percentage of jets on a wing's flight line that are ready to fly, dropped from 70.7 percent in 2003 to 61.2 percent in 2007, the lowest rate since 2001.

In contrast, the B-52H Stratofortress in 2007 had an availability rate of 65 percent and a mission-capable rate of 75.8 percent. The B-1Bs are used to drop LGBs and JDAMS in Iraq and Afghanistan. Their speed means it can cover the entire country. While the B-1B is twice as expensive to operate (per hour in the air) than the B-52, the B-1B can more quickly move to a new target over Afghanistan, which is particularly critical in close air support situations.

Because B-52s are cheaper to maintain and have a higher availability rate, the air force wants to keep 76 B-52s in service (despite a Congressional mandate to reduce that number to 56.) When the B-52 got the capability to deliver PGMs, it became the most cost-effective way to deliver support to ground forces. (It can remain on station for a long time, and it carries a lot of bombs!) The B-52 is the cheapest American heavy bomber to operate, and the oldest. The new sustainment program includes several upgrades, such as replac-



The incredible longevity of the B-52 can best be contemplated by realizing that there were still USAF B-17s and B-29s in service when the B-52 was born. The B-52 was a generational leap in technology in the 1950s, and it has remained relevant because the basic design has accommodated generational change in technology.

ing the 30 year old APQ-166 strategic radar. USAF wants a modern AESA (phased array) type radar, but is reluctant to spend that much on its old warhorse. The expense is not just in the radar upgrade. The addition of new communications gear will be required to allow the B-52s to participate in the real-time targeting network the air force is creating for its other attack aircraft. This network would also allow the warplanes to communicate with similar networks being built by the other services. The new sustainment program may give the B-52s even more advanced equipment after all. In its lifetime, the B-52 has had a lot of competition as the preeminent American bomber. In that time, the air force has developed six heavy bombers, including the 240 ton B-52 in 1955, the 74 ton B-58 in 1960, the 47 ton FB-111 in 1969, the 260 ton B-70 in the 1960s, the 236 ton B-1 in 1985, and the 181 ton B-2 in 1992. All were developed during the Cold

War, with the nuclear mission in mind. They have survived the “de-nuclearization” of the bomber force, and proven more capable at dropping non-nuclear bombs. Only the B-70 was cancelled before being deployed. The successors to the B-52 were more complex and expensive since they were designed to penetrate ever more formidable air defenses which existed within the presumed target environments of the time. In the war on terror, the B-52 needs none of these improvements for the bombing missions against foes with almost no air defenses against aircraft.

B-52Hs have an average of 16,000 flying hours on their airframes. USAF maintenance has kept them flying, and estimates are that the B-52s won't become un-maintainable until they reach 28,000 flight hours. The B-1 and B-2 were meant to provide a high tech replacement for the B-52, but the end of the Cold War made that impractical. The kinds of

anti-aircraft threats the B-1 and B-2 were designed to deal with never materialized. This left the B-52 as the most cost effective way to deliver bombs. The B-1s and B-2s are getting some of the same weapons carrying and communications upgrades as the B-52, if only because these more modern aircraft provide an expensive backup for the B-52. The B-1B and B-2 are more expensive to operate, just because of sophistication of design that doesn't necessarily contribute to their current missions. The B-1B goes fast down low, and crews still practice low level penetration missions. The B-2 was designed for stealth, but this radar masking capability is costly. When the B-52 was designed, air warfare was a lot simpler, and so was the BUFF. The rise of the new Russia, with worldwide territorial aspirations, and sophisticated air defenses, will keep the B-1s and B-2s relevant. The less sophisticated war on terror will keep the B-52 relevant.



An Air Force Flight Test Center B-52 Stratofortress from Edwards Air Force Base, Calif., carries an X-51A Waverider prior to the scramjet's first hypersonic flight test on March 26, 2010. Air Force engineers have made design modifications to the three remaining X-51A demonstrators and plan to resume the hypersonic flight test program in early spring of 2011. (U.S. Air Force photo)



A B-52 Stratofortress is on its way to a combat mission over Afghanistan. The B-52s provide close-air support for U.S. and coalition forces in support of Operation Enduring Freedom. (U.S. Air Force photo/Senior Master Sgt. John Rohrer)



(above) A B-52H Stratofortress takes off after being taken out of long term storage on 13 February 2015, at Davis-Monthan Air Force Base, Ariz. The aircraft was decommissioned in 2008 and spent seven years sitting in the “Boneyard,” before being selected to be returned to active status. The B-52 was flown by the 309th Aerospace Maintenance and Regeneration Group. (U.S. Air Force photo/ Master Sgt. Greg Steele)



A B-52H Stratofortress on the flight line at Minot AFB, North Dakota waits to be prepped for flight by her crew on a frigid January morning. The base experienced low visibility, sub below temperatures and gusts of wind up to 50 knots. (U.S. Air Force photo by A1C Christopher Boitz)



In 2013, USAF decided to increase the B-52H Stratofortress fleet's effectiveness and versatility by increasing the aircraft's smart weapons capacity by over 50 percent. Teams from Tinker Air Force Base, Oklahoma, Boeing, and Edwards AFB collaborated to begin developmental testing on the bombers newest upgrade, which concentrates on increasing the B-52's ability to carry a larger load of precision munitions. This new upgrade comes in the form of a Conventional Rotary Launcher (CRO), which members from the 419th Flight Test Squadron, the Global Power Bomber Combined Test Force and Boeing installed on an Edwards AFB B-52H. "The upgrade modifies the internal weapons bay of the B-52H bomber by integrating a CRL that has the capability of carrying Military Standard 1760 'smart weapons,'" said Jeff Lupton, the Boeing 1760 program manager. According to the Boeing test team, the upgrade is essential because it increases weapons capability on the external wing stations of the B-52H, while adding the smart weapons capability for the first time to the bomb bay.



Not your grandfather's B-52, but if estimates of the B-52's longevity are accurate, it might be your grandmother's! Maj. Andrea Jensen, 40th Expeditionary Group B-52 pilot, stands in front of a B-52 Stratofortress. Major Jensen has accumulated 100 combat flying hours providing close-air support for forces on the ground in Afghanistan. (U.S. Air Force photo/Senior Master Sgt. John Rohrer)



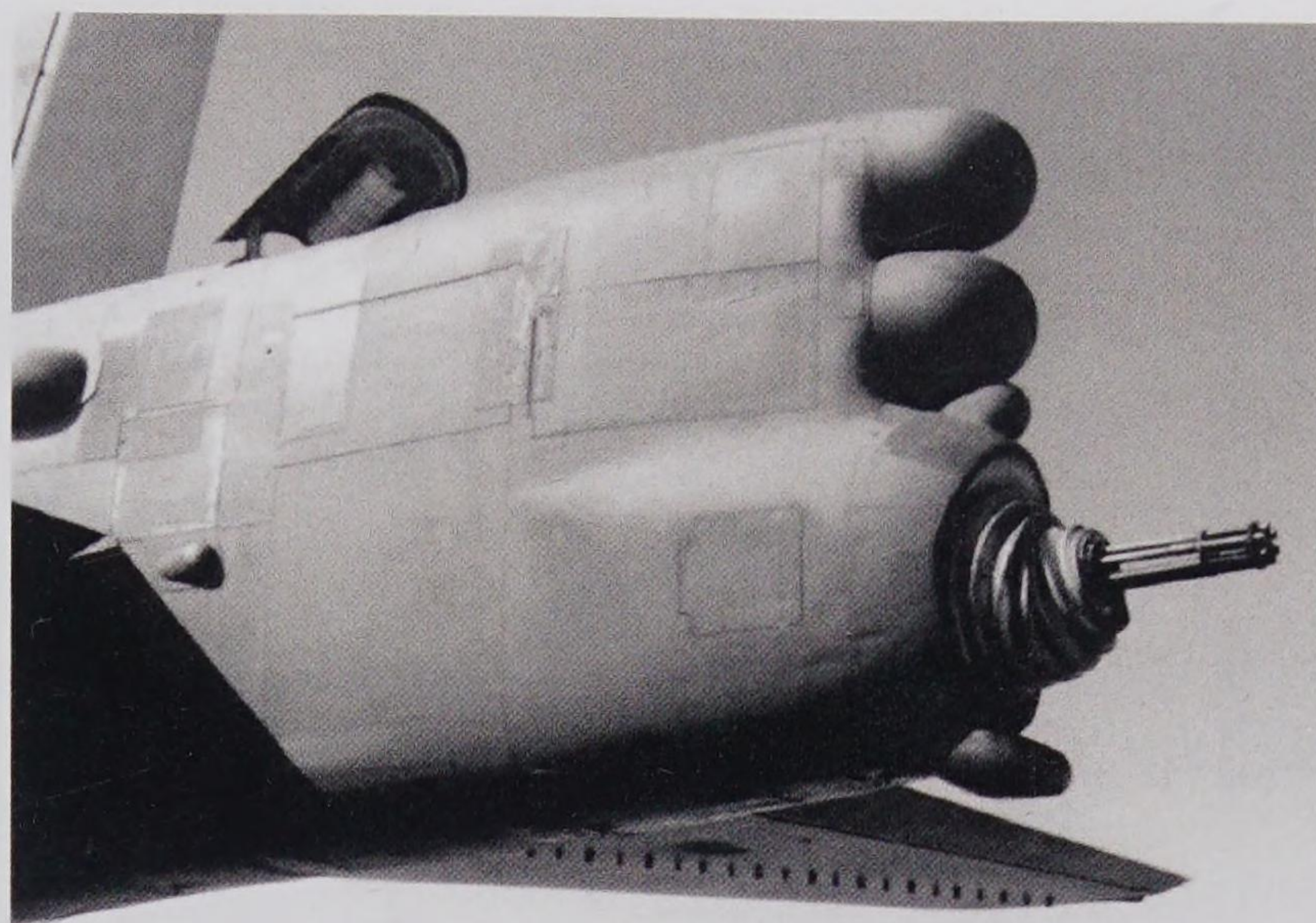
A B-52 Stratofortress from Andersen Air Force Base, Guam, is escorted by Hornets from the Royal Australian Air Force en route to the Delamere Bombing Range as part of the Green Lightning exercise in Australia. The Delamere Bombing Range facility in the Northern Territory is a world class military exercise site that allows many skills to be honed and tested. (Royal Australian Air Force photo/Flight Lt. Steven Bradley)



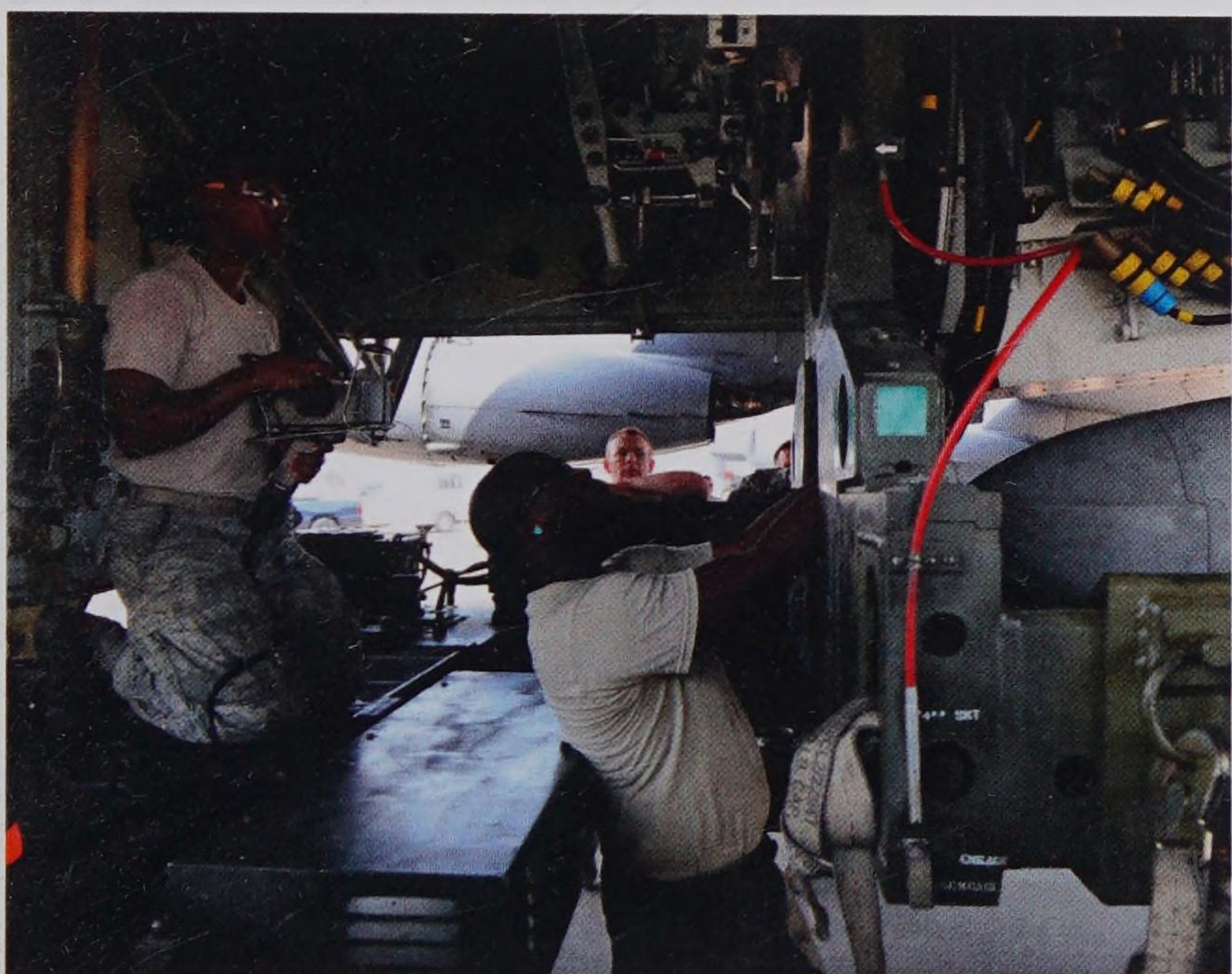
Members from the 5th Maintenance Squadron work hard on a B-52H Stratofortress at MinotAFB. A 1/4" crack was discovered while the aircraft was deployed to Guam, and resulted in an Air Force wide directed inspection for cracks. Through 5 months of planning and coordination with 4 bases, squadron members successfully completed a full aircraft jack and cradle repair of the B-52H. Fatigue cracks a common occurrence in aircraft as they age, and regular inspections often result in temporary grounding of the fleet for inspection and repair. (U.S. Air Force photo by Staff Sgt. Angel Gallardo)



Two B-52H tails stick out of a hanger on Barksdale Air Force Base, La. The B-52s undergo regular maintenance in the hangars, which are not large enough to accommodate the tails. (U.S. Air Force photo/Senior Airman Sean Martin)



The final iteration of the B-52 tail gun was the 20mm gatling gun, which was radar controlled by the gunner, who sat in the forward crew compartment. Changes in the threats to B-52s led to removal of the tail gun, and covering of the gun opening with a flat plate. All associated wiring for the gun was retained so that the guns could be re-installed if necessary. (USAF)



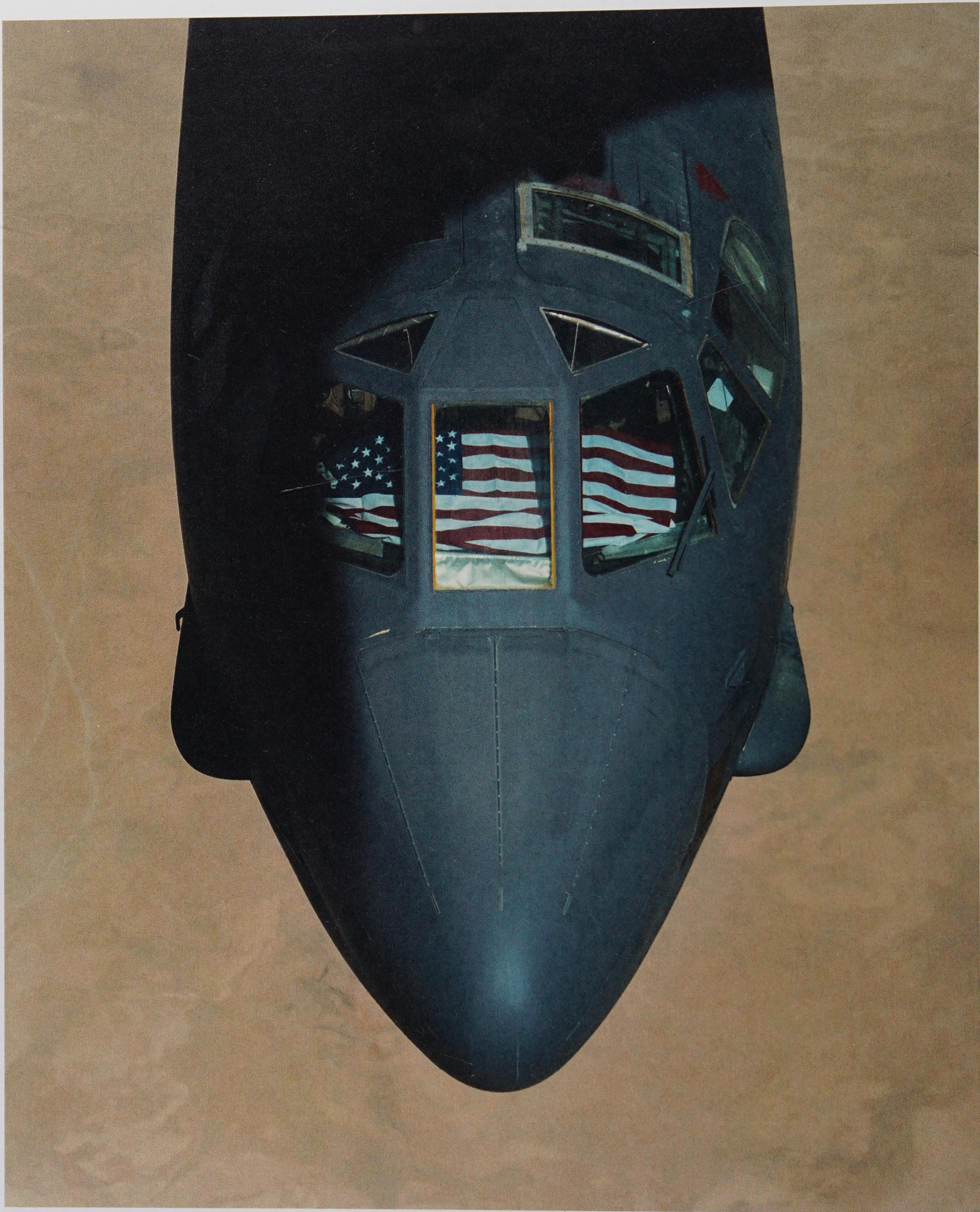
Senior Airman Breyana Anderson, left, and Staff Sgt. Raymond Edgerson, position an unarmed AGM-86B Air-Launched Cruise Missile for loading into the bomb bay of a B-52H Stratofortress at Barksdale AFB. The weapon was flown and released Sept. 22, as part of the Nuclear Weapons System Evaluation Program – an end-to-end operational evaluation of 8th Air Force and Task Force 204's ability to deliver an ALCM from storage to its final target. (U.S. Air Force photo/Senior Airman Benjamin Gonsier)



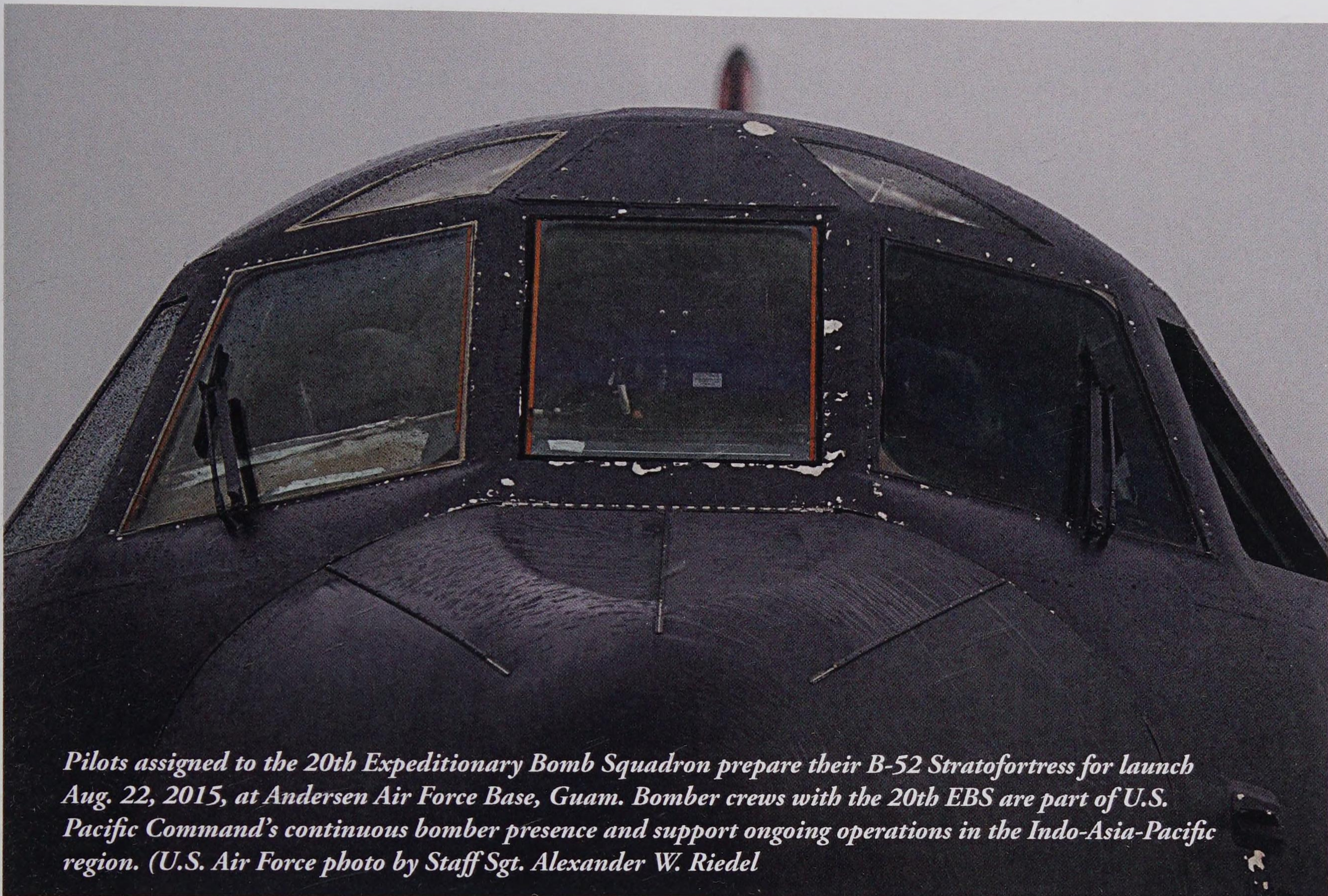
Staff Sgt. Brad Davis and Tech. Sgt. Kevin Rowe, 96th Aircraft Maintenance Unit crew chiefs, lower a new drag chute into the tail of a B-52H Stratofortress at Barksdale Air Force Base, La. (U.S. Air Force photo/Senior Airman Marleah Miller)

(below) B-52H rolls out with spoilers deployed (to kill lift) and the 43 foot ribbon drag chute fully deployed. When the BUFF turns off the runway, the chute will be dropped and picked up by ground crew.





A B-52 Stratofortress arrives to receive fuel from a KC-10 Extender during a mission in support of Operation Inherent Resolve over Iraq, Aug. 8, 2017. The B-52 is a long range, heavy bomber capable of flying at altitudes up to 50,000 feet. (U.S. Air Force photo/Staff Sgt. Trevor T. McBride)



Pilots assigned to the 20th Expeditionary Bomb Squadron prepare their B-52 Stratofortress for launch Aug. 22, 2015, at Andersen Air Force Base, Guam. Bomber crews with the 20th EBS are part of U.S. Pacific Command's continuous bomber presence and support ongoing operations in the Indo-Asia-Pacific region. (U.S. Air Force photo by Staff Sgt. Alexander W. Riedel)

(below) An Airman from the 20th Expeditionary Aircraft Maintenance Squadron prepares to taxi a B-52 Stratofortress Aug. 22, 2015, at Andersen Air Force Base, Guam. Bomber crews with the 20th EBS from Barksdale Air Force Base, Louisiana, are part of U.S. Pacific Command's Continuous Bomber Presence and support ongoing operations in the Indo-Asia-Pacific region. (U.S. Air Force photo by Staff Sgt. Robert Hicks)





A B-52 on the flightline at Andersen Air Force Base, Guam. (U.S. Air Force photo by Senior Airman Joshua Smoot)



A B-52 Stratofortress drops live guided bomb units as an F-15D Eagle follows during the Midway White III training exercise over the Nevada Test and Training Range on June 28, 2012. The data gathered from the training attacks executed in Midway White III is utilized to aid or enhance ongoing Defense Threat Reduction Agency programs. The B-52 is with the 340th Weapons School and the F-15D is with the 433rd Weapons School. (U.S. Air Force photo/Staff Sgt. Christopher Hubenthal)



Airmen from the 36th Logistics Readiness Squadron Fuels Flight and 36th Expeditionary Aircraft Maintenance Squadron refuel a B-52 Stratofortress July 2, 2013, before a mission on the Andersen Air Force Base, Guam, flightline. The 36th EAMXS was deployed here from Minot Air Force Base, N.D., in support of the 23rd EBS' Continuous Bomber Presence mission to provide extended deterrence and global strike capabilities. (U.S. Air Force photo by Airman 1st Class Marianique Santos/Released)

B-52 Stratofortress bombers from Barksdale Air Force Base, La., arrived at Al Udeid Air Base, Qatar, April 9, 2016, in support of Operation Inherent Resolve, the mission to rid the Islamic State of Iraq and the Levant in the region. The B-52 offers diverse capabilities including the delivery of precision weapons. (U.S. Air Force photo/Staff Sgt. Corey Hook)



(below) From left, Airman 1st Class Michael O'Donnell, Senior Airman James Rutt, and Senior Airman Ryandolph Alquetra, 36th Expeditionary Aircraft Maintenance Squadron weapons load crew team members, load an inert AGM-86 Conventional Air-Launched Cruise Missiles onto a B-52H Stratofortress during a munitions loading exercise July 13, 2016, at Andersen Air Force Base, Guam. A single B-52H can carry six AGM-86B/C/D missiles on each of two externally mounted pylons and eight internally on a rotary launcher, giving the B-52H a maximum capacity of 20 missiles. (U.S. Air Force photo by Airman 1st Class Alexa Ann Henderson)





A B-52 Stratofortress and crew arrives June 2, 2016, at Andersen Air Force Base, Guam. The aircraft is deployed in support of U.S. Pacific Command's Continuous Bomber Presence operations. Deployments such as this provide opportunities to advance and strengthen alliances as well as strengthen long-standing military-to-military partnerships. (U.S. Air Force photo by Airman 1st Class Alexa Ann Henderson/Released)

(below) Airman 1st Class Michael O'Donnell, left, Senior Airman James Rutt, 36th Expeditionary Aircraft Maintenance Squadron weapons load crew team members, load an inert AGM-158 Joint Air-to-Surface Standoff Missile onto a B-52H Stratofortress during a munitions loading exercise July 13, 2016, at Andersen Air Force Base, Guam. The exercise tested their ability to quickly and safely load a B-52H with munitions, which is integral to provide combat-ready aircraft in support of U.S. Pacific Command's continuous bomber presence mission. (U.S. Air Force photo by Airman 1st Class Alexa Ann Henderson)



The AGM-158 JASSM (Joint Air-to-Surface Stand-off Missile) is a low observable standoff air-launched cruise missile. It is a large, stealthy long-range weapon of the 2,000 pounds class. The missile's development began in 1995, but a number of problems during testing delayed its introduction into service until 2009. As of 2014, the JASSM has entered foreign service in Australia, Finland, and Poland. An extended range version of the missile, the AGM-158B JASSM-ER (Joint Air-to-Surface Standoff Missile-Extended Range), entered service in 2014. By September 2016, Lockheed Martin had delivered 2,000 total JASSMs comprising both variants to the USAF. The AGM-158A is powered by a Teledyne CAE J402 turbojet. Before flight the wings are kept folded to reduce size. Upon launch the wings flip out automatically. There is a single vertical tail.

Guidance is via inertial navigation with global positioning system updates. Target recognition and terminal homing is via an imaging infrared seeker. A data link allows the missile to transmit its location and status during flight, allowing improved bomb damage assessment. The warhead is a WDU-42/B 450 kg (1000 lb) penetrator.

The US Air Force studied various improvements to the AGM-158, resulting in the development of the JASSM-Extended Range (JASSM-ER), which received the designation AGM-158B in 2002. Using a more efficient engine and larger fuel volume in an airframe with the same external dimensions as the JASSM, the JASSM-ER is intended to have a range of over 575 miles (925 km) as compared to the JASSM's range of about 230 miles (370 km). Other possible improvements were studied but ultimately not pursued, including a submunition dispenser warhead, new types of homing head, and a new engine giving ranges in excess of 620 miles (1,000 km). The JASSM-ER has 70% hardware commonality and 95% software commonality with the original AGM-158 JASSM.

The JASSM-ER entered service with the USAF in April 2014. The B-52 outfitted with the 1760 Inter-

nal Weapons Bay Upgrade (IWBU) is able to carry 20 JASSM-ERs, eight internally and 12 on external pylons.



Members of the 36th Expeditionary Aircraft Maintenance Squadron conduct a post-flight inspection on a B-52 Stratofortress after its arrival June 2, 2016, at Andersen Air Force Base, Guam. They are checking for cracks in fan blades, which can have catastrophic consequences. (U.S. Air Force photo by Airman 1st Class Alexa Ann Henderson/Released)



Senior Airman Dan Katris, 23rd Expeditionary Bomb Squadron weapons loader deployed from Minot Air Force Base, N.D., positions a mechanical handling unit during weapons loading on a B-52 Stratofortress Nov. 26, at Andersen Air Force Base, Guam during the Aces North exercise. Aces North is a two week mission employment phase of the Australians version of the U.S. Air Force Weapons School. The exercise is scheduled to end Dec. 4. The bomber's participation in constant training helps emphasize the U.S. bomber presence, demonstrating U.S. commitment to the Pacific region. (U.S. Air Force photo/ Master Sgt. Kevin J. Gruenwald)



A B-52H Stratofortress flies over Minot Air Force Base, N.D., during a training exercise Nov. 3, 2013. In a conventional conflict, the B-52H can perform strategic attack, close-air support, air interdiction, offensive counter-air and maritime operations. (U.S. Air Force photo/Senior Airman Brittany Y. Auld)

With the Mauna Kea volcano in the background, a B-52 Stratofortress from the 23rd Expeditionary Bomb Squadron, flies over the Mauna Loa volcano, Hawaii, on Dec. 28, 2015, during a training mission. Two B-52 aircrews currently assigned here as part of the U.S. Pacific Command's continuous bomber presence, conducted a bomber Airmen heritage flyby of the Mauna Loa volcano. The flyby was part of the 80th anniversary of the 23rd Bombardment Squadron using bombs to divert lava flow from the volcano that threatened the town of Hilo, Hawaii, in 1935. (Courtesy photo)





Russian air force Col. Magomed Tolboev looks out from the cockpit of the U.S. B-52 Stratofortress bomber that landed here Aug. 20 for the 6th Moscow Space and Aviation Show. In Russia, Tolboev is revered much like test pilot Chuck Yeager is in the United States. He is a former Soviet Union pilot and cosmonaut who tested military aircraft at this once secret air base. The B-52 is assigned to the 5th Bomb Wing at Minot Air Force Base, N.D. (U.S. Air Force photo by Master Sgt. Kenneth Fidler)



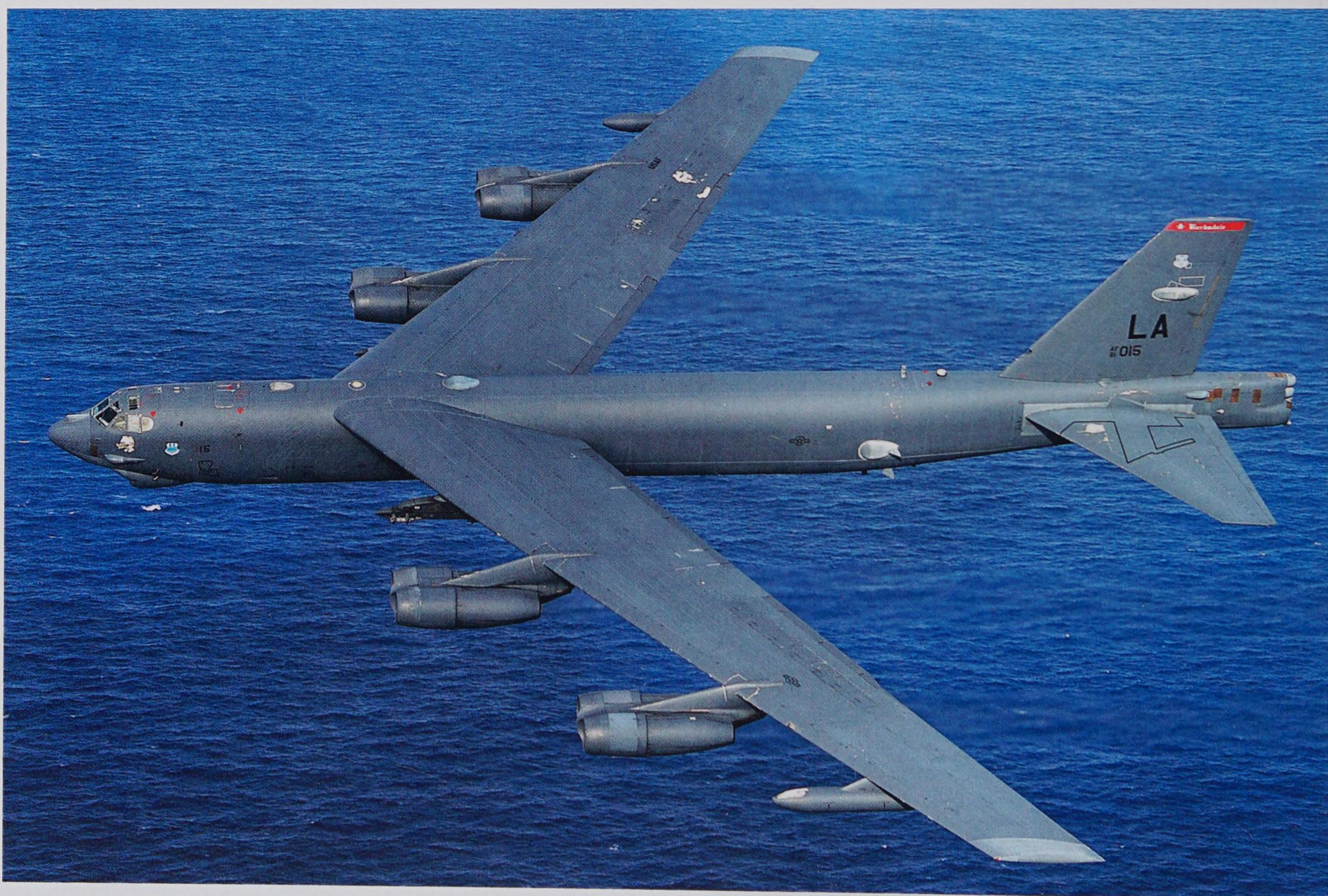
Maj. Eric Sikes gives a thumbs up sign from the cockpit of a B-52 Stratofortress Feb. 1 following his 17-hour flight from Barksdale Air Force Base, La., to Andersen AFB, Guam. Major Sikes was one of 300 Airmen from Barksdale AFB who arrived in Guam recently as part of a scheduled rotation of bomber units into the Pacific theatre. (U.S. Air Force photo/Senior Master Sgt. Don Perrien)



A B-52 Stratofortress, B-1B Lancer and B-2 Spirit sit beside one another on the flightline at Andersen Air Force Base, Guam, Aug. 10, 2016. The occasion marked the first time in history that all three of Air Force Global Strike Command's strategic bombers were positioned to simultaneously conduct operations in the U.S. Pacific Command region. (U.S. Air Force photo/Tech. Sgt. Richard Ebensberger)



An Italian Air Force Boeing 767 tanker refuels an Edwards B-52 over California's Mojave Desert on March 5, 2007. The tanker successfully extended its fifth generation, fly-by-wire air refueling boom and transferred fuel for the first time to another aircraft. (Photo by Jet Fabara)



A U.S. Air Force B-52H Stratofortress from the 96th Expeditionary Bomb Squadron flies off the coast of Guam during a photo exercise at Cope North 15, 17 February 2015. (U.S. Air Force photo by Tech. Sgt. Jason Robertson)



Airman 1st Class Nathan Jacobson performs liquid oxygen service to a B-52 Stratofortress at a forward-deployed location May 16 in preparation for a sortie supporting operations Iraqi Freedom and Enduring Freedom. He is a crew chief assigned to the 40th Expeditionary Maintenance Squadron. Air forces have long recognized the strategic importance of liquid oxygen, both as a fuel and as a supply of gaseous oxygen for breathing in hospitals and high-altitude aircraft flights. In 1985 the USAF started a program of building its own oxygen-generation facilities at all major consumption bases (U.S. Air Force photo by Staff Sgt. Jocelyn Rich)



Tech. Sgt. Jayson Kennedy, a fuels technician, prepares to attach the single point line to the B-52 Stratofortress at Barksdale Air Force Base, La., flightline Dec. 4, 2009. Sergeant Kennedy is assigned to the 917th Wing at Barksdale. (U.S. Air Force photo/Senior Airman Crystal Jordan)



A B-52H Stratofortress prepares to take off at Barksdale Air Force Base, La., April 1, 2015. The flight was part of a U.S. Strategic Command-directed mission to the Arctic and North Sea regions called "Polar Growl." Bomber operations provide a flexible and visible signal that highlights the U.S. ability to deter strategic attacks and respond to any potential future crisis or challenge. (U.S. Air Force photo/Airman 1st Class Curt Beach)

B-52 Units

A total of 744 B-52s were built, and less than 100 remain in active service. The only active operational model of the B-52 is the B-52H. It is currently stationed at two

USAF bases, flown by three wings

2d Bomb Wing – Barksdale AFB, Louisiana

11th Bomb Squadron (B-52H, Tail Code: LA, Gold Tail Stripe)

20th Bomb Squadron (B-52H, Tail Code: LA, Blue Tail Stripe)

96th Bomb Squadron (B-52H, Tail Code: LA, Red Tail Stripe)

5th Bomb Wing – Minot AFB, North Dakota

23d Bomb Squadron (B-52H, Tail Code: MT, Red Tail Stripe)

69th Bomb Squadron (B-52H, Tail Code: MT, Yellow Tail Stripe)

307th Bomb Wing (AFRC) – Barksdale AFB, Louisiana

93d Bomb Squadron (B-52H, Tail Code: BD, Blue/Gold Chex Tail Stripe)

343d Bomb Squadron

In its long and storied career, the B-52 has equipped several units, from coast-to-coast, and border-to-border. When it was a vital component of the nuclear triad, the B-52 stood alert at dozens of bases. This is a partial list of those units and bases, with the dates they flew the B-52:

2d Bombardment Wing (Heavy), Barksdale AFB, Louisiana

Activated by re-designation of: 4238th Strategic Wing
B-52E, 1963–1965; B-52G, 1965–1992; B-52H, 1992–present

11th Bombardment Squadron (B-52H)

20th Bombardment Squadron (B-52F/H) (to 7th BW 6/65 – from 7th BW 12/92)

62d Bombardment Squadron (B-52G) (from 39th BW 6/65, inactivated 12/92)

96th Bombardment Squadron (B-52H)

596th Bombardment Squadron (B-52G) (from 397th BW 4/68)

Currently flying B-52Hs at Barksdale AFB

5th Bombardment Wing (Heavy)

Travis AFB, California (1959–1968)

Minot AFB, North Dakota, (1968–Current)

B-52B, 1959; B-52G, 1959–1968; B-52H, 1968–Current

23d Bombardment Squadron

31st Bombardment Squadron (to 4126th SW 1/60)

72d Bombardment Squadron (B-52H)

Currently flying B-52Hs at Minot AFB.

6th Bombardment (later Strategic Aerospace) Wing, Walker AFB, New Mexico

B-52E, 1957–1967

24th Bombardment Squadron

39th Bombardment Squadron

40th Bombardment Squadron

4129th Combat Crew Training Squadron (1959–1963)

Moved to Eielson AFB, AK after closure of Walker AFB in 1967; 24th BS began flying RC-135s.

7th Bombardment Wing (Heavy), Carswell AFB, Texas

B-52E, 1958–1969; B-52D, 1969–1983; B-52H, 1982–1992

Moved to Dyess AFB, TX after closure of Carswell AFB and transfer to US Navy as NAS JRB Fort Worth/Carswell Field; became B-1B Wing (9th BS)

9th Bombardment Squadron

20th Bombardment Squadron (from 2d BW 6/65 to 2d BW 12/92)

492d Bombardment Squadron (to 4228th SW at Columbus AFB)

11th Bombardment (later Strategic Aerospace) Wing, Altus AFB, Oklahoma

B-52E, 1958–1968

26th Bombardment Squadron

98th Bombardment Squadron (Reassigned to 4123 SW at Carswell AFB 1958-1958 and relocated to Clinton-Sherman AFB in 1959)

42d Bombardment Squadron (Reassigned to 4043 SW in 1960)

Became KC-135 Air Refueling Wing in 1968

17th Bombardment Wing (Heavy)

Wright-Patterson AFB, Ohio (1963–1975)

Beale AFB, California, (1975–1976)

Activated to replace: 4043d Strategic Wing

B-52E, 1963–1968; B-52H, 1968–1975; B-52G, 1975–1976

34th Bombardment Squadron (B-52E a/c from 42 BS, B-52G a/c from 744 BS)

Inactivated in 1976; Beale AFB became a SAC Strategic Recon base for SR-71 and U-2 operations.

19th Bombardment Wing (Heavy)

Homestead AFB, Florida (1962–1968)

Robins AFB, Georgia (1968–1983)

B-52H, 1962–1968; B-52G, 1968–1983

28th Bombardment Squadron (B-52G a/c from 781st BS, 7/68)

Became 19th Air Refueling Wing in 1983

22d Bombardment Wing (Heavy), March AFB, California

B-52B, 1963–1966; B-52D, 1966–1982

2d Bombardment Squadron

486th Bombardment Squadron (B-52D a/c from 781st BS)



Air pressure valves are used to control and monitor the pressure in air lifts under a B-52 Stratofortress at Barksdale Air Force Base, La., Feb. 16, 2017. Three Airmen monitoring each of system had to communicate via radio to ensure the lifts remained balanced between each wing. (U.S. Air Force photo/Senior Airman Luke Hill)

The 22d Bombardment Squadron became 22d Air Refueling Wing in 1982,
and the 2d Bombardment Squadron became the 2d Strategic Squadron in 1988,

28th Bombardment Wing (Heavy), Ellsworth AFB, South Dakota

B-52D, 1957–1971; B-52G, 1971–1977; 1977–1985

77th Bombardment Squadron

717th Bombardment Squadron (Reassigned to 4245 SW in 1960)

718th Bombardment Squadron (Reassigned to 4128 SW in 1960)

Equipped with B-1B Lancer in 1986

39th Bombardment Wing (Heavy), Eglin AFB, Florida

Activated to replace: 4135th Strategic Wing

B-52G, 1963–1965

62d Bombardment Squadron (a/c from 301st BS; to 2d BW 6/65) Inactivated in 1965; Eglin AFB SAC facilities transferred to TAC

42d Bombardment Wing (Heavy), Loring AFB, Maine
B-52C, 1956–1957; B-52D, 1957–1959; B-52G, 1959–1994

69th Bombardment Squadron

70th Bombardment Squadron (inactivated 6/66; a/c to 528 BS/380 SAW)

75th Bombardment Squadron (Reassigned to 4039 SW in 1959)

Inactivated in 1994; Loring AFB closed per BRAC

Inactivated in 1994; Loring AFB closed per BRAC

43d Strategic Wing, Andersen AFB, Guam

B-52D, 1972–1983; B-52G, 1983–1990

60th Bombardment Squadron

63d Bombardment Squadron (Provisional), 1972–1973

Inactivated in 1990; Andersen transferred to PACAF

68th Bombardment Wing (Heavy), Seymour Johnson AFB, North Carolina
Activated to replace: 4241st Strategic Wing
B-52G, 1963–1982

51st Bombardment Squadron (a/c from 73d BS)

Became 68th Air Refueling Wing in 1982

Airmen from the 96th Bomb Squadron, prepare a B-52H Stratofortress for takeoff at Ellsworth Air Force Base, South Dakota, prior to a 15.5-hour sortie to the U.S. Southern Command area of operations Aug. 11, 2014. Assigned to the 2nd Bomb Wing, Barksdale Air Force Base, Louisiana, the aircraft and seven-person aircrew participated in PANA-MAX 2014, an annual U.S. Southern Command-sponsored exercise designed to provide multinational interoperability training in complex operations. (U.S. Air Force photo by Airman 1st Class Rebecca Imwalle)



70th Bombardment Wing (Heavy), Clinton-Sherman AFB, Oklahoma Activated to replace: 4123d Strategic Wing
B-52E, 1963–1968; B-52D, 1968–1969
6th Bombardment Squadron (a/c from 98 BS)
Inactivated in 1969; Clinton-Sherman AFB closed.

72d Bombardment Wing (Heavy)
Ramey AFB, Puerto Rico (1959–1971)
Andersen AFB, Guam (1972–1973)
B-52G, 1959–1971, 1972–1973
60th Bombardment Squadron (transferred to 43d SW in 1971)
Inactivated in 1971; Ramey AFB closed; portion transferred to US Coast Guard as AIRSTA Borinquen

Provisional wing at Andersen for Linebacker I, II 1972–1973 (Vietnam War)
91st Bombardment Wing (Heavy), Glasgow AFB, Montana
Activated to replace: 4141st Strategic Wing
B-52D, 1963–1968
322d Bombardment Squadron
Inactivated in 1968; Glasgow AFB closed; Became 91st Strategic Missile Wing in 1968 at Minot AFB
92d Bombardment (later Strategic Aerospace) Wing, Fairchild AFB, Washington

B-52D, 1957–1971; B-52G, 1970–1986; B-52H, 1986–1994

325th Bombardment Squadron
326th Bombardment Squadron (B-52D) (Reassigned to 4141 SW in 1961)
327th Bombardment Squadron (B-52D) (Reassigned to 4170 SW in 1961)
Became 92d Air Refueling Wing in 1994

93d Bombardment Wing (Heavy), Castle AFB, California
B-52B, 1955–1965; B-52D, 1956–1958; B-52E, 1957–1958, 1967–1970; B-52F, 1958–1974; B-52G, 1966–1967, 1974–1994; B-52H, 1974–1993
328th Bombardment Squadron
329th Bombardment Squadron
330th Bombardment Squadron (1955–1963) (1998–1991)
4017th Combat Crew Training Squadron (1955–1956)
Inactivated in 1995; Castle AFB closed per BRAC.

95th Bombardment Wing (Heavy), Biggs AFB, Texas
B-52B, 1959–1966
334th Bombardment Squadron (1959–1966)
Inactivated in 1966; Biggs AFB closed and transferred to US Army as Biggs AAF.

96th Strategic Aerospace Wing, Dyess AFB, Texas

B-52E, 1963–1970; B-52D, 1969–1982; B-52H, 1982–1985

337th Bombardment Squadron

Inactivated in 1993; Dyess AFB became B-1B base Jun 1985

97th Bombardment Wing (Heavy), Eaker AFB, Arkansas

B-52G, 1960–1992

340th Bombardment Squadron

Inactivated in 1992; Eaker AFB closed per BRAC; became

97th Airlift Wing at Altus AFB in 1992

99th Bombardment Wing (Heavy), Westover AFB, Massachusetts

B-52C, 1956–1966; B-52B, 1958–1959; B-52D, 1957–1961, 1966–1974

346th Bombardment Squadron

347th Bombardment Squadron (Reassigned to 4047 SW in 1961)

348th Bombardment Squadron

Inactivated in 1974; Westover AFB transferred to Air Force Reserve as Westover ARB.

306th Bombardment Wing (Heavy), McCoy AFB, Florida
Activated to replace: 4047th Strategic Wing

B-52D, 1963–1973

367th Bombardment Squadron (a/c from 347 BS)

Inactivated in 1974; McCoy AFB closed. Became 306th Strategic Wing at RAF Mildenhall, UK in 1975

307th Strategic Wing, U-Tapao RTNAF, Thailand

B-52D, 1973–1975

364th Bombardment Squadron (Provisional)

365th Bombardment Squadron (Provisional)

Inactivated in 1975; USAF ops at U-Tapao RTAFB closed out and transferred to Royal Thai Air Force.

319th Bombardment Wing (Heavy), Grand Forks AFB, North Dakota Activated to replace: 4133d Strategic Wing

B-52H, 1963–1982; B-52G, 1982–1986

46th Bombardment Squadron (a/c from 30th BS)

Equipped with B-1B Lancer 1987–88

Became 319th Air Refueling Wing in 1994

320th Bombardment Wing (Heavy), Mather AFB, California Activated to replace: 4134th Strategic Wing

B-52F, 1963–1968; B-52G, 1968–1989

441st Bombardment Squadron (a/c from 72d BS)

Tenant SAC unit on ATC base. Inactivated in 1989; Mather AFB closed in 1991 per BRAC.

340th Bombardment Wing (Heavy), Bergstrom AFB, Texas
Activated to replace: 4130th Strategic Wing

B-52D, 1963–1966

486th Bombardment Squadron (a/c from 335 BS)

Inactivated in 1966; reactivated and equipped with FB-111s

in 1968

366th Wing (Headquartered at Mountain Home AFB, Idaho; aircraft located at Castle AFB, California)

B-52G, 1992–1994

34th Bombardment Squadron

34 BS equipped with B-1B Lancers in 1994

376th Strategic Wing, Kadena AB, Okinawa

4180th Bombardment Squadron (Provisional) (never made operational)

Equipped with RC-135s in 1970 when B-52s withdrawn from Kadena AB.

379th Bombardment Wing (Heavy), Wurtsmith AFB, Michigan

B-52H, 1961–1977; B-52G, 1977–1992

524th Bombardment Squadron

Inactivated in 1993; Wurtsmith AFB closed per BRAC

380th Strategic Aerospace Wing, Plattsburgh AFB, New York

B-52G, 1966–1971

528th Bombardment Squadron (a/c from 70th BS)

Re-equipped with FB-111s in 1971; Inactivated 1995 and Plattsburgh AFB closed per BRAC

397th Bombardment Wing (Heavy), Dow AFB, Maine

Activated to replace: 4038th Strategic Wing

B-52G, 1963–1968

596th Bombardment Squadron (a/c from 341st BS)

Inactivated in 1968; Dow AFB closed.

410th Bombardment Wing (Heavy), K. I. Sawyer AFB, Michigan Activated to replace 4042d Strategic Wing

B-52H, 1963–1994

644th Bombardment Squadron (a/c from 526th BS)

Inactivated in 1995; K. I. Sawyer AFB closed per BRAC

416th Bombardment Wing (Heavy), Griffiss AFB, New York Activated to replace 4039th Strategic Wing

B-52G, 1963–1992; B-52H, 1992–1995

668th Bombardment Squadron (a/c from 75th BS)

Inactivated in 1995; Griffiss AFB closed per BRAC.

449th Bombardment Wing (Heavy), Kincheloe AFB, Michigan Activated to replace 4239th Strategic Wing

B-52H, 1963–1977

716th Bombardment Squadron (a/c from 93d BS)

Inactivated in 1977; Kincheloe AFB closed

450th Bombardment Wing (Heavy), Minot AFB, North Dakota Activated to replace 4136th Strategic Wing

B-52H, 1963–1968

720th Bombardment Squadron (a/c from 525th BS)
Inactivated in 1968

454th Bombardment Wing (Heavy), Columbus AFB, Mississippi Activated to replace 4228th Strategic Wing
B-52F, 1963–1966; B-52D, 1966–1969

736th Bombardment Squadron (a/c from 492d BS)
Inactivated in 1969; Columbus AFB transferred to ATC

456th Strategic Aerospace (later Bombardment) Wing, Beale AFB, California

B-52G, 1963–1975

Activated to replace 4126th Strategic Wing

744th Bombardment Squadron (a/c from 31st BS, a/c to 34th BS) Wing Inactivated in 1975, replaced by 17th Bombardment Wing

461st Bombardment Wing (Heavy), Amarillo AFB, Texas
B-52D, 1963–1968 Activated to replace 4128th Strategic Wing

764th Bombardment Squadron (a/c from 718 BS)
Inactivated in 1968; Amarillo AFB closed.

462d Strategic Aerospace Wing, Larson AFB, Washington
Activated to replace 4170th Strategic Wing

B-52D, 1963–1966

768th Bombardment Squadron (a/c from 327 BS)
Inactivated in 1966; Larson AFB closed.

465th Bombardment Wing (Heavy), Robins AFB, Georgia
Activated to replace 4137th Strategic Wing

B-52G, 1963–1968

781st Bombardment Squadron (a/c from 342d BS)

Tenant SAC unit on AFLC base; Inactivated in 1968

484th Bombardment Wing (Heavy), Turner AFB, Georgia

Activated to replace 4138th Strategic Wing

B-52D, 1963–1967

824th Bombardment Squadron (a/c from 336 BS)

Inactivated in 1967; Turner AFB closed and transferred to US Navy in 1968 as NAS Albany.

494th Bombardment Wing (Heavy), Sheppard AFB, Texas
Activated to replace 4245th Strategic Wing



A U.S. Air Force B-52 Stratofortress leads a formation of aircraft, including two Polish air force F-16 Fighting Falcons, four U.S. Air Force F-16 Fighting Falcons, two German Eurofighter Typhoons and four Swedish Gripens over the Baltic Sea, June 9, 2016. The formation was part of exercise BALTOPS 2016. (U.S. Air Force photo/Senior Airman Erin Babis)

B-52D, 1963–1966

864th Bombardment Squadron (a/c from 717 BS)

SAC tenant unit on ATC base; Inactivated in 1966

509th Bombardment Wing (Heavy), Pease AFB, New Hampshire

B-52D, 1966–1969

393d Bombardment Squadron

Re-equipped with FB-111s in 1970; Inactivated 1995, Pease AFB transferred to Air National Guard as Pease ANGB per BRAC

43d Strategic Wing, Andersen AFB, Guam B-52D, 1972–1983; B-52G, 1983–1990 60th Bombardment Squadron 63d Bombardment Squadron (Provisional), 1972–1973 Inactivated in 1990; Andersen transferred to PACAF

68th Bombardment Wing (Heavy), Seymour Johnson AFB, North Carolina Activated to replace: 4241st Strategic Wing B-52G, 1963–1982 51st Bombardment Squadron (a/c from 73d BS) Became 68th Air Refueling Wing in 1982

70th Bombardment Wing (Heavy), Clinton-Sherman AFB, Oklahoma Activated to replace: 4123d Strategic Wing B-52E, 1963–1968; B-52D, 1968–1969 6th Bombardment Squadron (a/c from 98 BS) Inactivated in 1969; Clinton-Sherman AFB closed.

72d Bombardment Wing (Heavy) Ramey AFB, Puerto Rico (1959–1971) Andersen AFB, Guam (1972–1973) B-52G, 1959–1971, 1972–1973 60th Bombardment Squadron

(transferred to 43d SW in 1971) Inactivated in 1971; Ramey AFB closed; portion transferred to US Coast Guard as AIRSTA Borinquen Provisional wing at Andersen for Linebacker I, II 1972–1973 (Vietnam War)

91st Bombardment Wing (Heavy), Glasgow AFB, Montana Activated to replace: 4141st Strategic Wing B-52D, 1963–1968 322d Bombardment Squadron Inactivated in 1968; Glasgow AFB closed; Became 91st Strategic Missile Wing in 1968 at Minot AFB

92d Bombardment (later Strategic Aerospace) Wing, Fairchild AFB, Washington B-52D, 1957–1971; B-52G, 1970–1986; B-52H, 1986–1994 325th Bombardment Squadron 326th Bombardment Squadron (B-52D) (Reassigned to 4141 SW in 1961) 327th Bombardment Squadron (B-52D) (Reassigned to 4170 SW in 1961) Became 92d Air Refueling Wing in 1994

93d Bombardment Wing (Heavy), Castle AFB, California B-52B, 1955–1965; B-52D, 1956–1958; B-52E, 1957–1958, 1967–1970; B-52F, 1958–1974; B-52G, 1966–1967, 1974–1994; B-52H, 1974–1993 328th Bombardment Squadron 329th Bombardment Squadron 330th Bombardment Squadron (1955–1963) (1998–1991) 4017th Combat Crew Training Squadron (1955–1956) Inactivated in 1995; Castle AFB closed per BRAC.



A U.S. Air Force B-52 Stratofortress takes off from Andersen Air Force Base (AFB), Guam, Aug. 24, 2016. The B-52s have served non-stop rotations since 2006, which have been shared between the bomber squadrons from Minot AFB, N.D., and Barksdale AFB, La. The B-1B Lancer officially replaced the B-52 Stratofortress in support of U.S. Pacific Command's Continuous Bomber Presence mission Aug. 15, during a Transfer of Authority ceremony. (U.S. Air Force photo by Tech. Sgt. Richard P. Ebensberger/Released)

95th Bombardment Wing (Heavy), Biggs AFB, Texas B-52B, 1959–1966
334th Bombardment Squadron (1959–1966)
Inactivated in 1966; Biggs AFB closed and transferred to US Army as Biggs AAF.

96th Strategic Aerospace Wing, Dyess AFB, Texas B-52E, 1963–1970; B-52D, 1969–1982; B-52H, 1982–1985
337th Bombardment Squadron
Inactivated in 1993; Dyess AFB became B-1B base Jun 1985



Airmen 1st Class Kevin Carmel (Left), and Julius Smith, 36th Expeditionary Aircraft Maintenance Squadron crew chiefs deployed from Minot Air Force Base, N.D., remove chocks from the tires of a B-52 Stratofortress during a preflight check at Andersen Air Force Base, Guam, April 2, 2013. A new rotation of aircrews, maintenance personnel and aircraft arrived to Guam March 31 to replace the 96th Expeditionary Bomb Squadron in support of U.S. Pacific Command's continuous bomber presence mission. (U.S. Air Force photo by Senior Airman Benjamin Wiseman/Released)

(below) Lightning strikes behind a B-52H Stratofortress at Minot Air Force Base, N.D., Aug. 8, 2017. In the authors experience (trying to dodge weather in a small airplane), thunderstorms in the Northern United States can be particularly strong and produce spectacular visuals like this (U.S. Air Force photo/Senior Airman J.T. Armstrong)





A B-52 Stratofortress, from Minot Air Force Base, N.D., flies near the North Pole, July 31, 2016, during Polar Roar, a strategic deterrence exercise. The rapid global mobility and air refueling capabilities of Air Mobility Command and the 305th Air Mobility Wing ensured the B-52's were able to complete their mission. (U.S. Air Force photo/Senior Airman Joshua King)



A B-52 Stratofortress from the 69th Expeditionary Bomb Squadron, Minot Air Force Base, N.D., performs the crab walk, March 15. The crab walk enables the B-52 to land in crosswinds with its landing gears straight while the aircraft is turning into the wind. The pilots test these capabilities before taking off to make sure everything works properly. (U.S. Air Force photo/ Senior Airman Carlin Leslie)



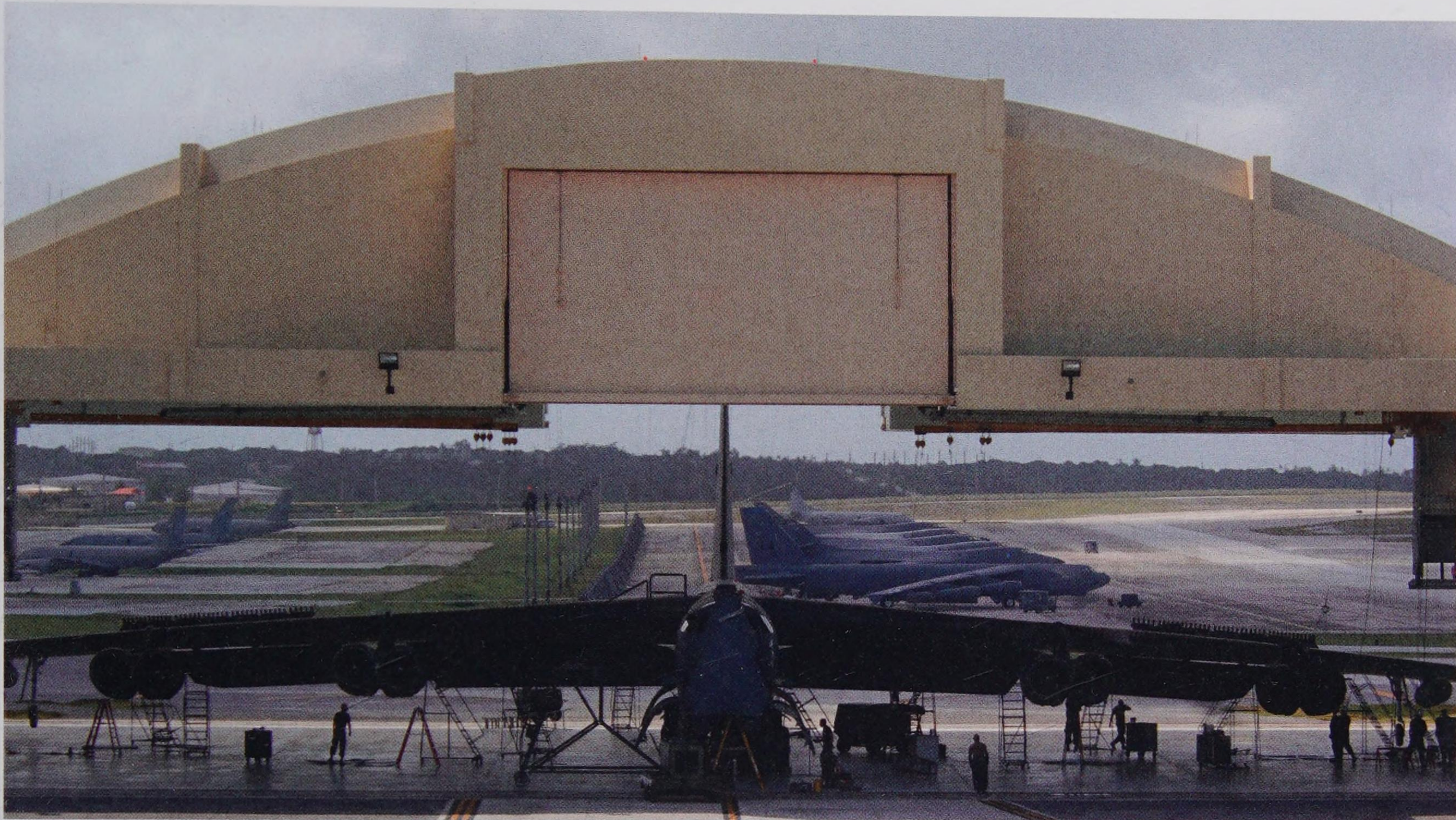
Capt. Jason McNutt maneuvers his B-52 Stratofortress into position beneath a KC-135 Stratotanker for aerial refueling. The B-52 bomber crew from the 40th Expeditionary Bomb Squadron dropped 45 500-pound bombs on targets in Iraq on April 4. (U.S. Air Force photo by Tech. Sgt. Richard Freeland)



BARKSDALE AIR FORCE BASE, La. -- Two weapons loaders download a bomb from a B-52 Stratofortress during a conventional operational readiness exercise. The exercise tests the wing's warfighting capability. The weapons loaders are with the 2nd Munitions Squadron. (U.S. Air Force photo by Staff Sgt. Denise A. Rayder)



1st Lt. Nicola Hill does her pre-flight inspection before flying a 10-hour mission across the Pacific in a B-52 Stratofortress from Andersen Air Force Base, Guam. She and her fellow B-52 aircrew members practice techniques they would use in actual combat missions. Lieutenant Hill is a B-52 pilot from the 96th Expeditionary Bomb Squadron deployed from Barksdale AFB, La. (U.S. Air Force photo/Staff Sgt. Vanessa Valentine)



ANDERSEN AIR FORCE BASE, Guam (AFPN) -- B-52 Stratofortress mechanics inspect their aircraft during phase maintenance at Hangar 1 here. The Airmen are members of the 2nd Maintenance Squadron based at Barksdale Air Force Base, La. The B-52s come here from a forward-deployed location and go into phase maintenance after 300 flying hours. The \$34-million hangar is the newest in the Air Force and can house any type of Air Force aircraft. (U.S. Air Force photo by Master Sgt. Val Gempis)



(above, right) Airman Eric Andreasen (left) and Senior Airman Michael Schaff change a tire on a B-52 at Minot Air Force Base, N.D.. The Airmen are from the 5th Aircraft Maintenance Squadron at Minot AFB. (U.S. Air Force photo/Master Sgt. Lance Cheung)

(above) Senior Airman Christopher Hirsch works on the landing gear of a B-52 deployed to Andersen Air Force Base, Guam. Airman Hirsch is deployed with the 36th Expeditionary Aircraft Maintenance Squadron, 7,000 miles from his home station at Barksdale AFB, La. The 36th EAMXS has generated more than 110 sorties in support of Pacific theater operations. (U.S. Air Force photo/Senior Master Sgt. Don Perrien)





Mechanics remove the engine ring cowl of their B-52 Stratofortress aircraft during phase maintenance at Hangar 1 here at Andersen AFB, Guam. The Airmen are deployed from the 2nd Maintenance Squadron based at Barksdale Air Force Base, La. The B-52s come here from a forward-deployed location and go into phase maintenance after 300 flying hours. The \$34-million hangar is the newest in the Air Force and can house any type of Air Force aircraft. (U.S. Air Force photo by Master Sgt. Val Gempis)



Airmen assigned to the 20th Expeditionary Bomb Squadron at Barksdale Air Force Base, La., inspect the bomb bay of a B-52 Stratofortress after arriving at Al Udeid Air Base, Qatar, April 9, 2016, to support Operation Inherent Resolve. The cavernous bomb bay of the B-52 is the central repository of its capability of carrying up to 70,000 pounds of weapons, including the latest precision-guided munitions, in a variety of missions including strategic attack, close-air support, air interdiction and maritime operations. (U.S. Air Force photo/Tech. Sgt. Nathan Lipscomb)



OPERATION IRAQI FREEDOM -- A maintenance crew begins the process to wash the 159-foot long B-52 Stratofortress bomber April 7 at a forward-deployed location. More than a dozen workers took six hours to clean oil, grease and dirt off the four-decade old airplane, which is part of the coalition bombing effort in Iraq. (U.S. Air Force photo by Tech. Sgt. Jason Tudor)



A B-52 Stratofortress taxis to the runway at Minot Air Force Base, N.D., Aug. 21. The bomber from the 5th Bomb Wing conducted a training mission in the skies over North Dakota. This view also provides a seldom-seen view of the sensor pods on the nose of the B-52H(U.S. Air Force photo/Master Sgt. Lance Cheung)



Members of the 2nd Maintenance Squadron wait to tow a B-52 at Barksdale Air Force Base, La., Feb. 28, 2017. A0049 was part of Operation Allied Force in 1999, meant to ensure an ending to all military action, violence and repression in Kosovo and a withdrawal of Serbian military, police and paramilitary forces. This BUFF is about to get a complete engine change as a part of its overhaul. (U.S. Air Force photo/Airman 1st Class Stuart Bright)



Members of the 577th Commodities and Reclamation Squadron cut a B-52G Stratofortress Dec. 19, 2013, at the 309th Aerospace Maintenance and Regeneration Group, Davis-Monthan Air Force Base, Ariz. Under the New START Treaty the aircraft is cut into two pieces separating the tail from the fuselage in order for Russia's satellites to verify the aircraft's elimination. (U.S Air Force photo/Staff Sgt. Angela Ruiz)





Thirty-three aircrew members from the 36th Expeditionary Bomb Squadron stand in formation to represent the 33 crewmembers who died during Operation Linebacker II Dec. 13, 2013, on Andersen Air Force Base, Guam. The Linebacker II ceremony observed the 41st year of the campaign that led to the end of the Vietnam War and honored the sacrifice and commitment the service members made. The B-52, known as "Old 100" stood as a memorial to Linebacker crews. (U.S. Air Force photo by Airman 1st Class Emily A. Bradley/Released)



Airmen from the 36th Maintenance Squadron prepare to dismantle the vertical tail section of the "Old-100" static display B-52D Stratofortress at Arc Light Memorial Park on Andersen Air Force Base, Guam, March 22, 2014. The aircraft is being removed due to irreparable deterioration from weather after being on display for more than 30 years. This is the second B-52 at Arc Light Park that has suffered the effects of corrosion on Guam. (U.S. Air Force photo by Staff Sgt. Melissa B. White/



(above) Air Force Global Strike Command officials assumed responsibility for the Air Force's nuclear-capable bomber force, including the B-52 Stratofortress and B-2 Spirit shown here, Feb. 1, 2010. This action completes the step-by-step transfer of all Air Force long-range, nuclear-capable assets to the Air Force's newest major command. (U.S. Air Force photo)

(below) A B-52 Stratofortress from the 2nd Bomb Wing participates in Vigilant Shield 15 Oct. 24, 2014, at 5 Wing Goose Bay, Newfoundland and Labrador, Canada. The Vigilant Shield field training exercise is a bi-national North American Aerospace Defense Command exercise that provides realistic training and practice for American and Canadian forces. NORAD ensures U.S. and Canadian air sovereignty through a network of alert fighters, tankers, airborne early warning aircraft, and ground-based air defense assets cued by interagency and defense surveillance radars. (U.S. Air Force photo/Senior Airman Justin Wright)





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